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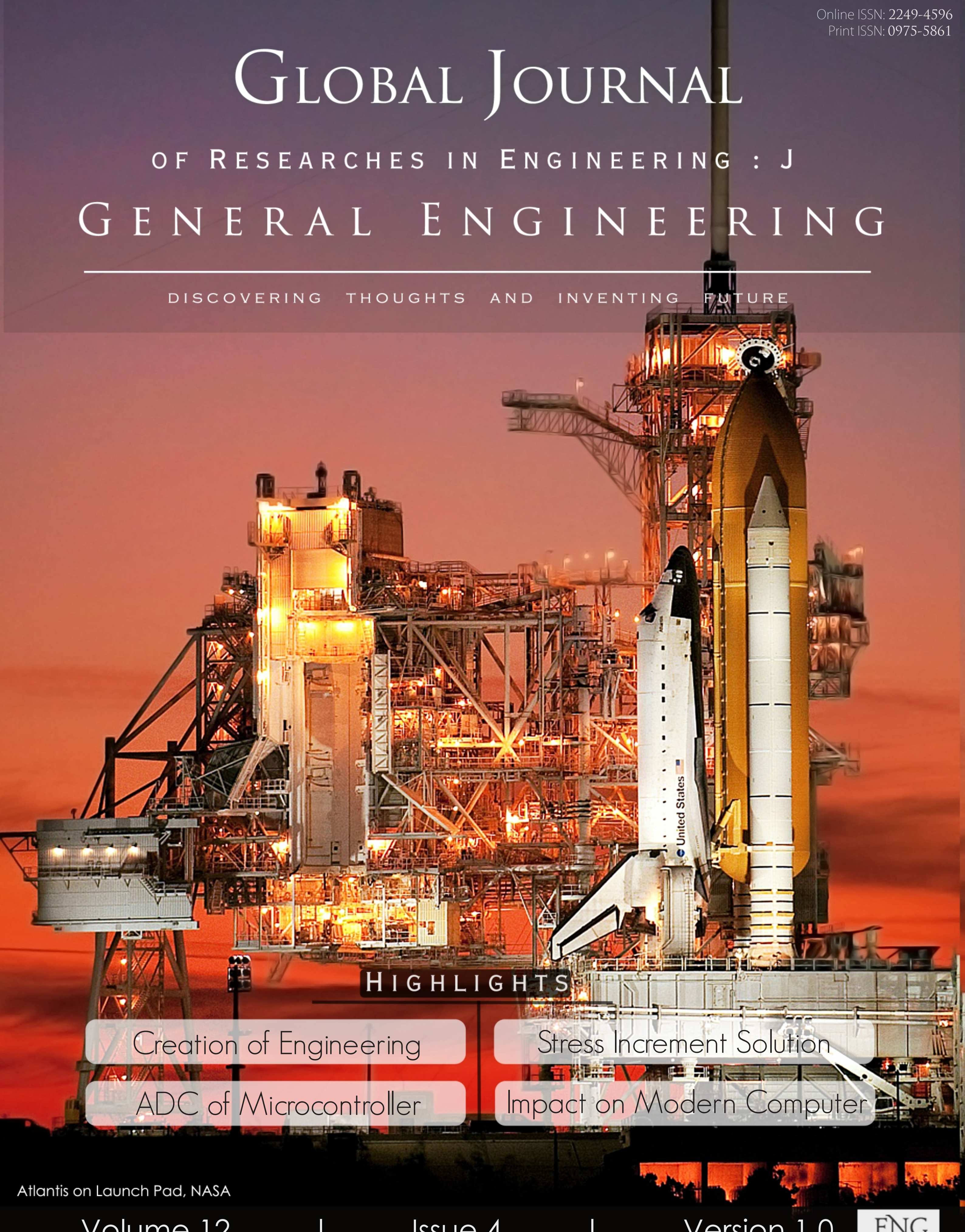

HIGHLIGHTS

Creation of Engineering

Stress Increment Solution

ADC of Microcontroller

Impact on Modern Computer

Atlantis on Launch Pad, NASA

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The History of the Creation of Engineering Careers in México and its Relationship with Social Innovation

By Vega-González Luís Roberto
Universidad Nacional Autonoma de Mexico

Abstract - There is an intuitive relationship between the creation of engineering careers and the social innovation in any country. In the global scenery a nation's economy is the main driver of its social innovation. As in all countries, engineering careers in Mexico have always been closely related to the economic activity through the assimilation, operation and maintenance of the technological platforms used by the nation's public and private organizations to perform their operations. Technological change has been a major factor influencing engineering education in last decade provoking that Mexican engineers needed to expand their actuation areas to attend more than just the industry's operative needs. Today Mexican engineers are also involved in research and development innovation projects. Through an investigation of the history of the creation and evolution of the engineering careers based in the available data of the Facultad de Ingenieria (FI) de la Universidad Nacional Autonoma de Mexico (UNAM), in this paper we intend to show that in the country engineering careers and professionals always have had a relevant actuation in its development and have been behind the economic and social innovation processes.

Keywords : *engineering careers, Mexico, economic & social innovation.*

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I. Introduction: Engineering Careers, Fostering Social Innovation

Vandervert [25] noted that innovation has to be with the production of new useful ideas and products and it is normally associated to projects that are the media where individuals creativity and talent be transformed into the ideas and or products that people wish to use, contributing to solve important society problems; this phenomena is called firm innovation. Technology is created in innovation projects and is embodied as tools, products, processes, methods, systems and procedures for specific purposes. Bas, et., al. [1].

Economic innovation is typically associated with the creation of wealth for individuals, companies and nations. Khalil & Ezzat, [12].

For Sternberg, et al., [23], cited by Vandervert (op. cit., pp. 1103) aggregated innovation effects convert in a *social force* driving different knowledge fields. As Major & Cordey Hayes [14] indicate, innovation is characterized for the production of *flows* and combinations of knowledge and information. In summary the main product of innovation projects is knowledge in many types. Organizations must develop an appropriation capacity for the knowledge developed in the economic innovation processes in order to finally produce commercial benefits. Teece [24]; Moser, [18].

In the whole complex society the macroeconomic phenomena described produces gradually changes improving people's living standards and provoking Society *innovation* as the final main result of the process.

Many different professionals, organizations and individuals participate in the economic & society innovation processes. Reducing the complexity of the phenomena, Figure 1 intends to show what are the engineering actuation areas within the continuous processes described. As in all the world, in third world counties the basic activities of engineering individuals are related to the operation & maintenance of industrial plants, systems and devices. Nowadays engineers also participate in research, technology and new product development projects producing new products, promoting enterprise competitiveness and generating an important economic spill out. Engineers normally work within public and private firms and organizations; although, in Latin-American countries, and particularly in Mexico, only big firms have their own capacities to perform innovation projects. To overcome this problem there are research and development public government financed institutions that can help micro and small enterprises with their R&D requirements.

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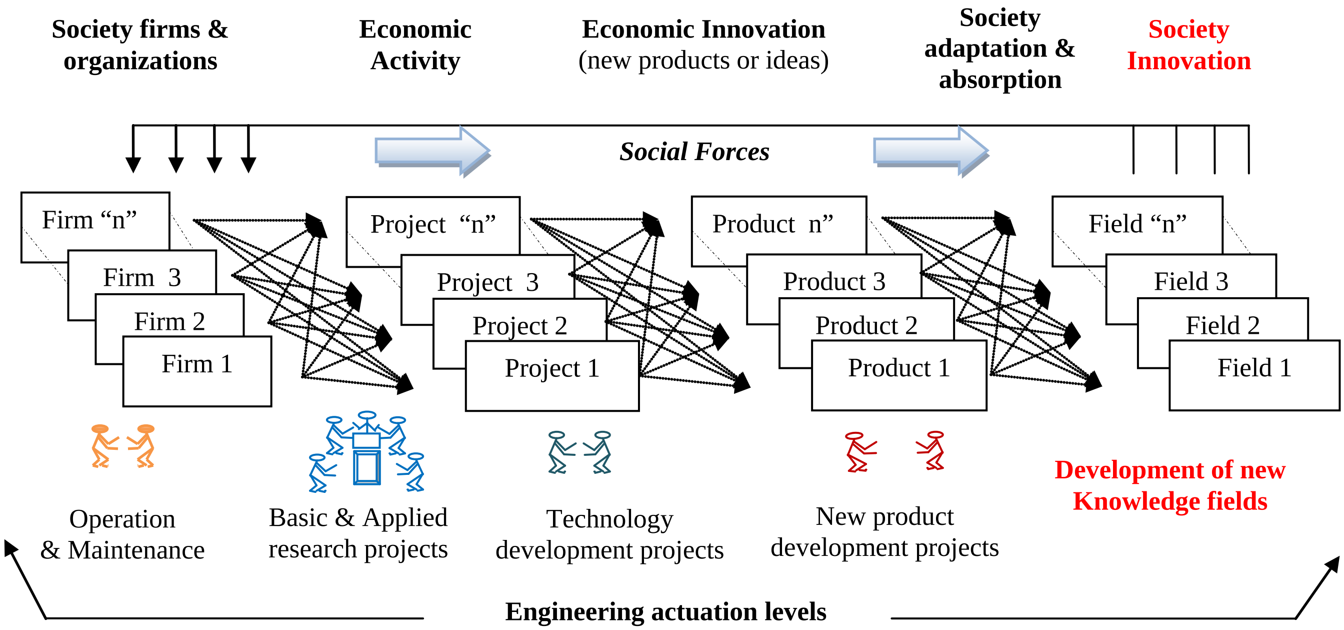

Figure 1 : Engineering actuation level for Economic & Society Innovation

In the next section we will review the historical creation and the evolution of the engineering careers in Mexico in the context of the technological platforms available and related to the economic and social innovation processes.

II. Engineering Careers Evolution In Mexico (<1500 To 2000 AC)

As in other countries, Mexican engineers schools and faculties have been immersed in the response of the education's societal system to the basic population problems. In Figure 2 it can be seen that during the main part of the Spanish Colony years (1500-1800 AC), construction engineering professionals were in charge of constructions for living, water handling and food, merchandize and people transportation. The main economic activities were the mining exploitation, the agriculture, the livestock and the commerce; the first formal engineering career in Mexico was *Mines* created in 1792 at the Hospicio de San Nicolas Hidalgo in Michoacan.

By the end of eighteen century (1800-1850 AC), basic industrial chemical processes for breweries, beverages, food, pharmacy, paper production, steel, cooper, tanneries, rubber and heavy machinery sawmills appeared. The first steam electric power plants were installed and the first refineries began to work.

During all XIX century the engineer careers available to respond to those active industrial sectors were: *construction*, *mining*, *geologist*, *topography*, *textile* and chemical engineering. Figure 3

The Universidad Nacional was created in 1910 including the Engineers National School. In 1915 the *hydraulic and construction* career and the *mechanical & electrical* engineer practical school were created. Díaz & Saldaña [6].

The Escuela Nacional de Química Industrial (ENQI) was founded in 1916 and incorporated to the Universidad Nacional Autonoma de Mexico (UNAM).

The career of *chemical engineer* was created in 1925. Later on, in 1938 the *oil engineering career* was created to attend oil refineries and petrochemical plants. The *geologist* career was created about 1940 to back up the intensive oil exploration works developed by the oil industry.

To address the waste disposal needs of the new industries and the growing cities, the *municipal* and *sanitary engineering careers* were created contemporarily to design and develop the sewage system required for the cities and the industrial waste water treatment plants.

In 1929 the Universidad Nacional got converted in the Universidad Nacional Autónoma de México (UNAM) and the Escuela Nacional de Ingenieros was transformed in the Facultad de Ingeniería de la UNAM (FI-UNAM) having the primary objectives of maintaining the existing careers and to create the new ones required in order to respond to the country's intense ongoing industrialization process.

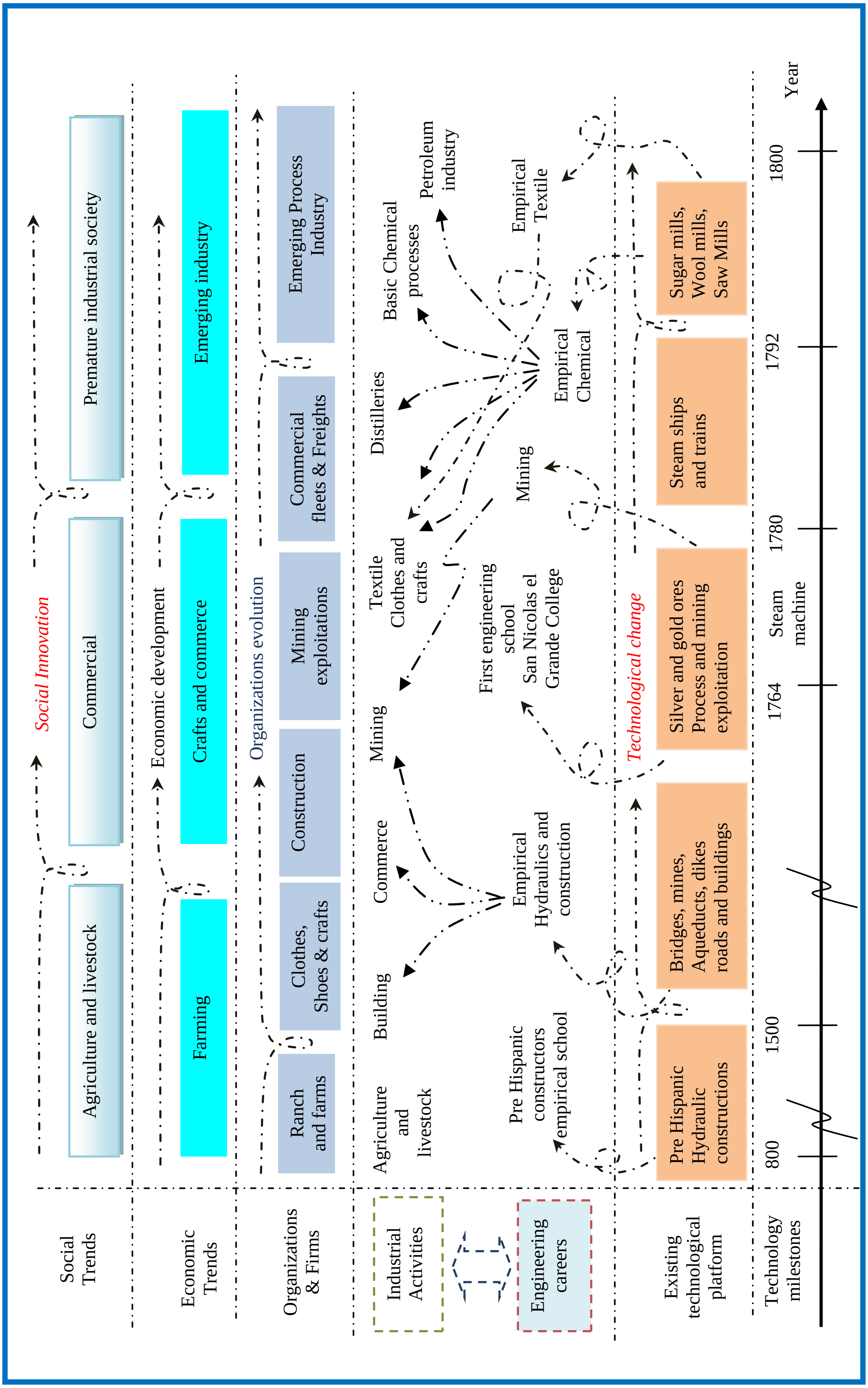

Figure 2 : Engineering careers, technological platform and social innovation (1500-1800 AC)

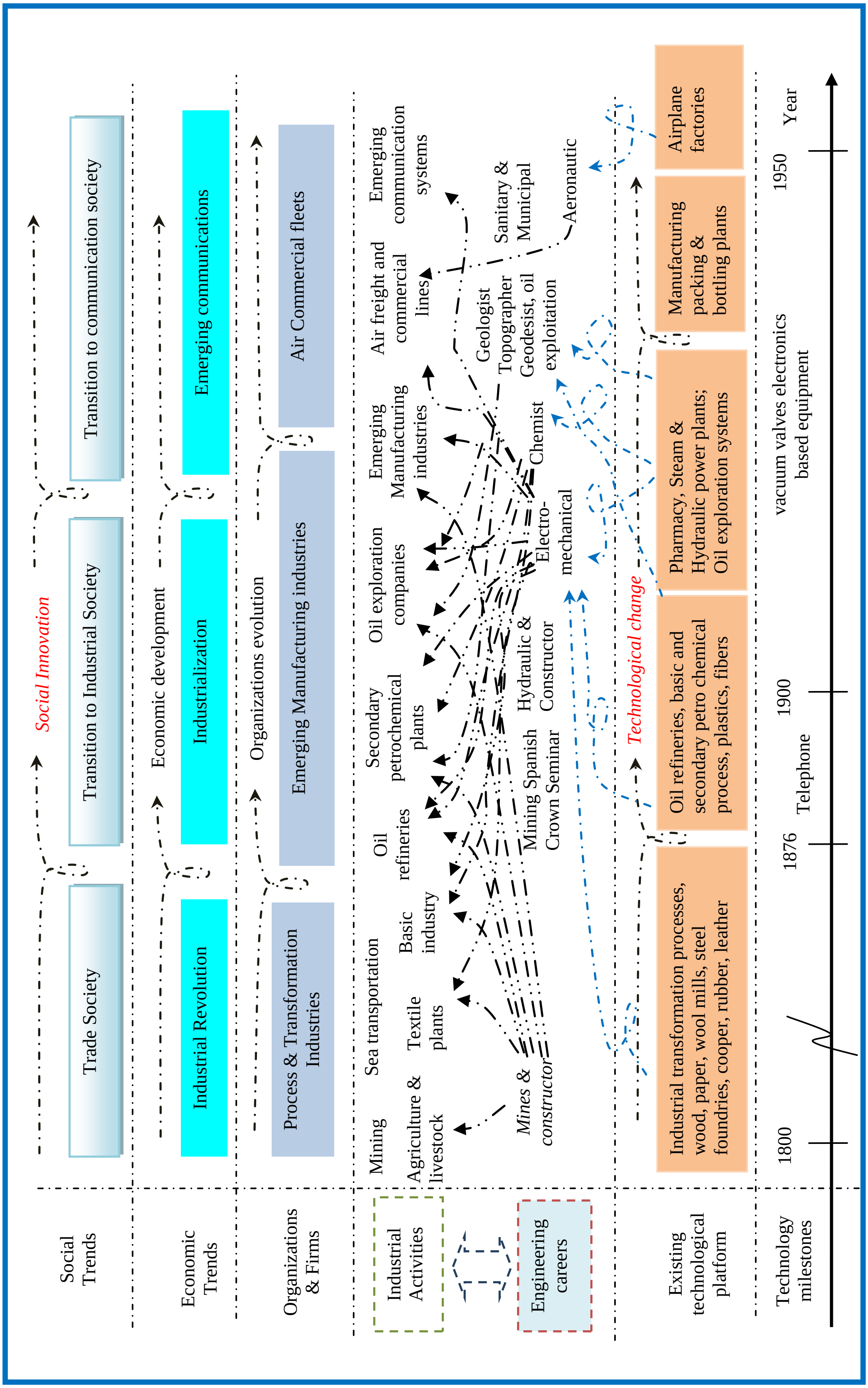

Figure 3 : Engineering careers, technological platform and social innovation (1800-1950 AC)

By 1950 the engineering careers offered by the FI-UNAM were: *construction, geology, electromechanical, topography, geodesist, petroleum exploitation, mines and metallurgy, sanitary and municipal and aeronautical*. The scope of the *electromechanical* career included the emerging technologies of the communications industries such as telegraphy, telephone, radio broadcasting and television.

The intense use of mainframe computers in the middle of the seventies determined the creation of the *computation engineer* career in 1981. The *geophysics* career was also created in 1981.

Internet technology was available at the end of the twentieth century giving origin to the globalization phenomena. The *electromechanical engineering* career got transformed in the *mechanical*, *electrical*, *electronic*, and *industrial* engineering careers responding to the intense technological change. Drucker [7].

III. Engineering Careers And Technological Change (2000-2030 AC)

According with Saito [20], the technological convergence of the computer and communications systems come out with the commercial availability of the global satellite communication broadband networks and the Internet technologies transforming the world in a global village. Mc. Luhan, [17]. The globalization phenomena changed the way world economies design, produce, distribute and make the consumption of goods and services. Widdig & Lohmann, [26].

It was difficult for the firms to be converted in global organizations, Landry [13], but convergence permitted to the society members to have easier and transparent access to health, education, commerce and government services overcoming bureaucratic and geographic barriers. Chareonwongsak, [4].

Communication devices and technologies including satellite communication systems suffered intense number of innovations during the end of last century. Cellular phone systems emerged with the dissemination of fiber optics and satellite networks all over the world impacting world economics and all aspects of modern life, including entertainment. Pretty soon a new Internet version appeared including new technologies for data processing including audio, video, and images. Economic analysts consider this phenomenon as a new technological revolution, the TIC Revolution. The world main influencing technologies were the computers and communications (TIC).

A special technological field supported by the availability of the high velocity satellite networks, the fastest memories and powerful processors has been the telemedicine. Since the nineties it has been a continuous development of complex medical diagnostics systems based in medical imaging. Today the public health systems work in base to huge standardized data bases. The telesurgery will be a common procedure in the very near future. *Biomedical engineering career* was created to attend those fields in conjunction with the electrical and electronics engineers.

The industrial society got transformed into the new information society, Geisler, [10]; Sanchez, [21]. The professional people required to back up the new industries needed to have knowledge in electronics, computers and telecommunication fields. Responding to this phenomenon, the *telecommunications engineering* career was created in 1994. See Figure 4.

During last decade's intense global research and development has been carried in different areas, some examples are: new materials, micro electromechanical systems (MEM), and nanotechnology. It is expected in the very near future the commercial availability of the biological chips. World is in the way for the absolute convergence; next step will be the bio-convergence.

One of the R&D fields with an extraordinary growth is the biotechnology, particularly in the case of the investigations behind the food and bio pharmaceutical drugs. The biotechnology term refers to the methods and techniques used to produce substances from raw materials using living organisms. Sasson, [22].

It is expected that the continuous evolution of the capacities of the computational systems, will promote the evolution of the genetics R&D to produce human organs in lab which will be available in market ready to be transplanted some time ahead. The future petacomputers will be capable to perform a thousand trillion of floating point operations and eventually could be used in many auxiliary processes in order to modify the human's evolution. The petacomputer networks could eventually reach an intelligence superior to the one of the human being. Martin, [15].

The development of the emerging research fields is based in the intense interaction of the existing scientific knowledge and it depends in the last generation technological devices required for doing the research. Techno-science is the new field that recognizes the synergy and interdependence of research and technology and it is frequently associated with complex systems studies.

Many medium and big size manufacturing firms and chemical transformation process industries evolved in Mexico during the second half of last century. They always look forward for finding safely ways to increase productivity better quality standards using clean technologies and auto sustainable production systems. Figure 4

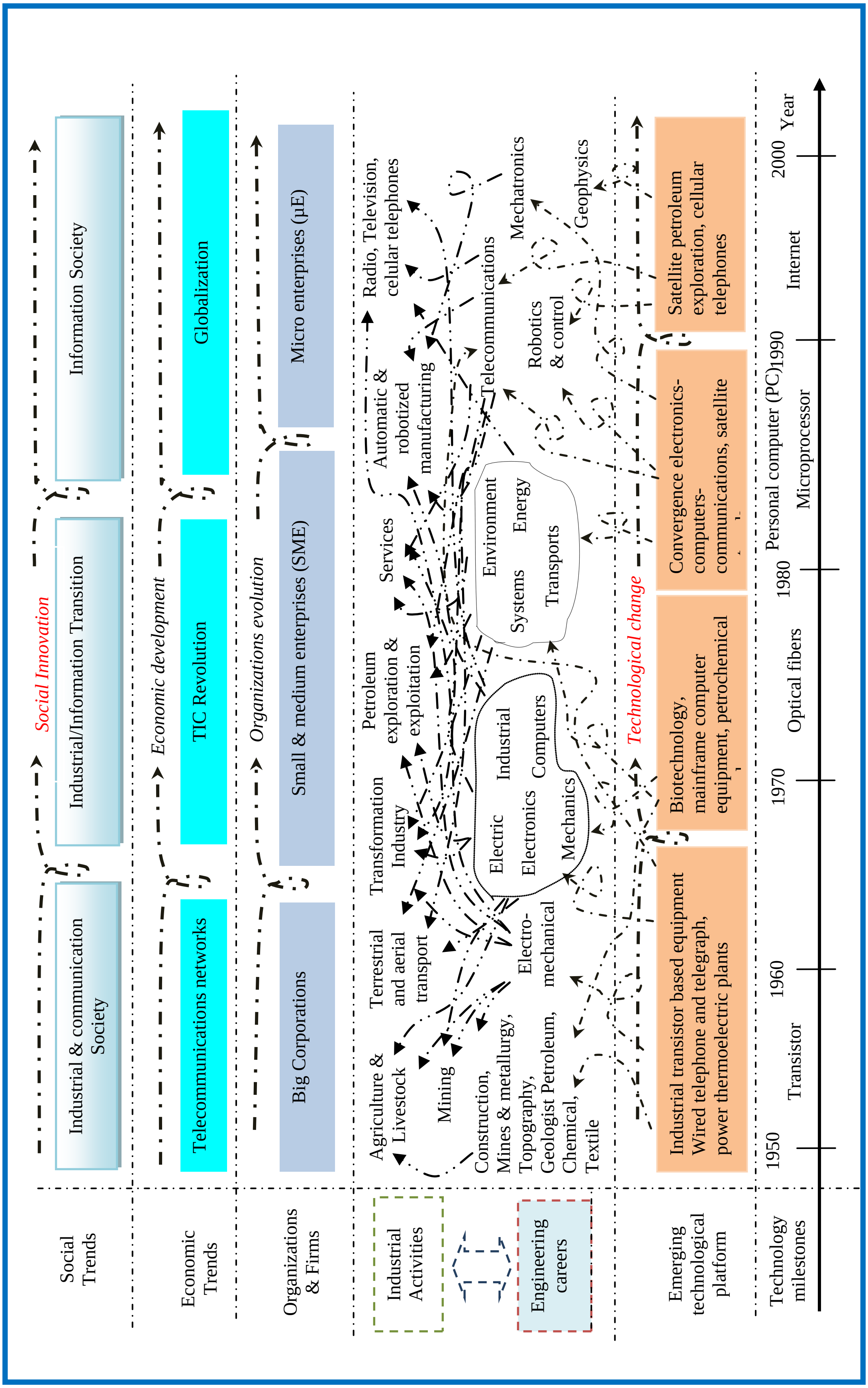

Figure 4 : Engineering careers, technological platform and social innovation (1950-2000 AC)

IV. The Last Thirty Years Economic Transformations & New Careers For Next Decades

Driven by the intense technological change and in order to be profitable, around the last quarter of the last century, enterprises diminished their size producing the gradual transformation of the big corporative firms in to small and micro enterprises (SME's). Today it is estimated that the SME's conform about 97% of the country economic units in Mexico, and are responsible of the generation of more than 50% of the Gross National Product. Diario Oficial de la Federación, [5].

In the new age the consumer required tailored products according to their own specifications. Competitors passed from being national to international and increased in number. In front of this situation, the enterprise learned to be flexible and to be tuned for new product manufacturing, understanding the importance of product diversification.

In a high turbulent environment with new consuming standards, continuously increasing technological change and global markets with growing number of regulations and competitors, enterprises needed to move fast in order to learn how to develop innovating products adapted to the new highly competed business environment. Bessant, [2].

High volume serial production systems became over passed, the new business scheme required adaptable production systems. The firm had to be capable to be organized in short time to produce the small quantity goods included in a purchase order.

To compete and survive in the new global market the SME's required to be highly specialized in some knowledge fields, identifying their core competences and learning to innovate promoting a new innovation culture. Foster, [9]; Campbell & Sommers, [3]; Zien & Buckler, [27].

The new market required complex products and in order to be successful SME's needed to establish strategic alliances with the big firms instead of competing with them. To get the production parts required from any place in the world the use of global services was essential. Eraydin & Armatli, [8].

The feasibility of the new global production scheme depended on the innovation networks. Internet was the technological tool responsible of their development. Rothwell [19]; Hinterhuber & Levin, [11]. Virtual enterprises appeared with the capability of changing its size integrating the number of people required according with the project to be performed, case to case.

In this environment, to increase quality, and to lower production costs new technological tools were required. Computer aided design (CAD) and computer aided manufacturing (CAM) systems were available in the market. In a short time they were used by SME's and virtual engineering and manufacturing firms for their innovation projects. To succeed firms required to be flexible and capable to learn and develop new knowledge based products. The phenomenon occurred globally fostering the emergence of the knowledge economy in which the knowledge was recognized as the main production factor. In that regard the *mechatronics engineering* career, was created in 2004 to prepare the professionals required to attend the automated and manufacturing robotic systems production industrial requirements.

Technological change dynamic processes have been increasing in this century. Everything indicates that tendencies will continue and therefore innovation will be favored by the new technology developed along.

Testing the society absorption capacity, hundreds of new scientific and technological knowledge based products will be launched to market. Trying to respond to this phenomenon in 2007 the UNAM created the *technology engineering career* to produce the professionals required to support this apparently never ending process.

In the near future biological systems possibly will be the biggest growing knowledge field launching to market hundreds of new high value products transforming the world industry configuration giving birth to a new economic system: the bioeconomy. Mc. Kelvey [16], therefore we expect the development of the *bioengineering career* by the end of this decade or the beginning of the next. The convergent knowledge domains probably be biological and biotechnological processes along with electronic, computers, telecommunication system and nanotechnology.

V. Conclusions

As we have seen, during the last 200 years engineering professionals in Mexico have been acting between the existing technological platforms and the firms pushing economy development and producing social innovation through the knowledge development.

Engineering professionals actuation working in the different organizations of the different economic sectors produced a *social force* capable to drive different knowledge fields while producing knowledge embodied in many different products and physical artifacts through the *flows* and combinations of knowledge and information.

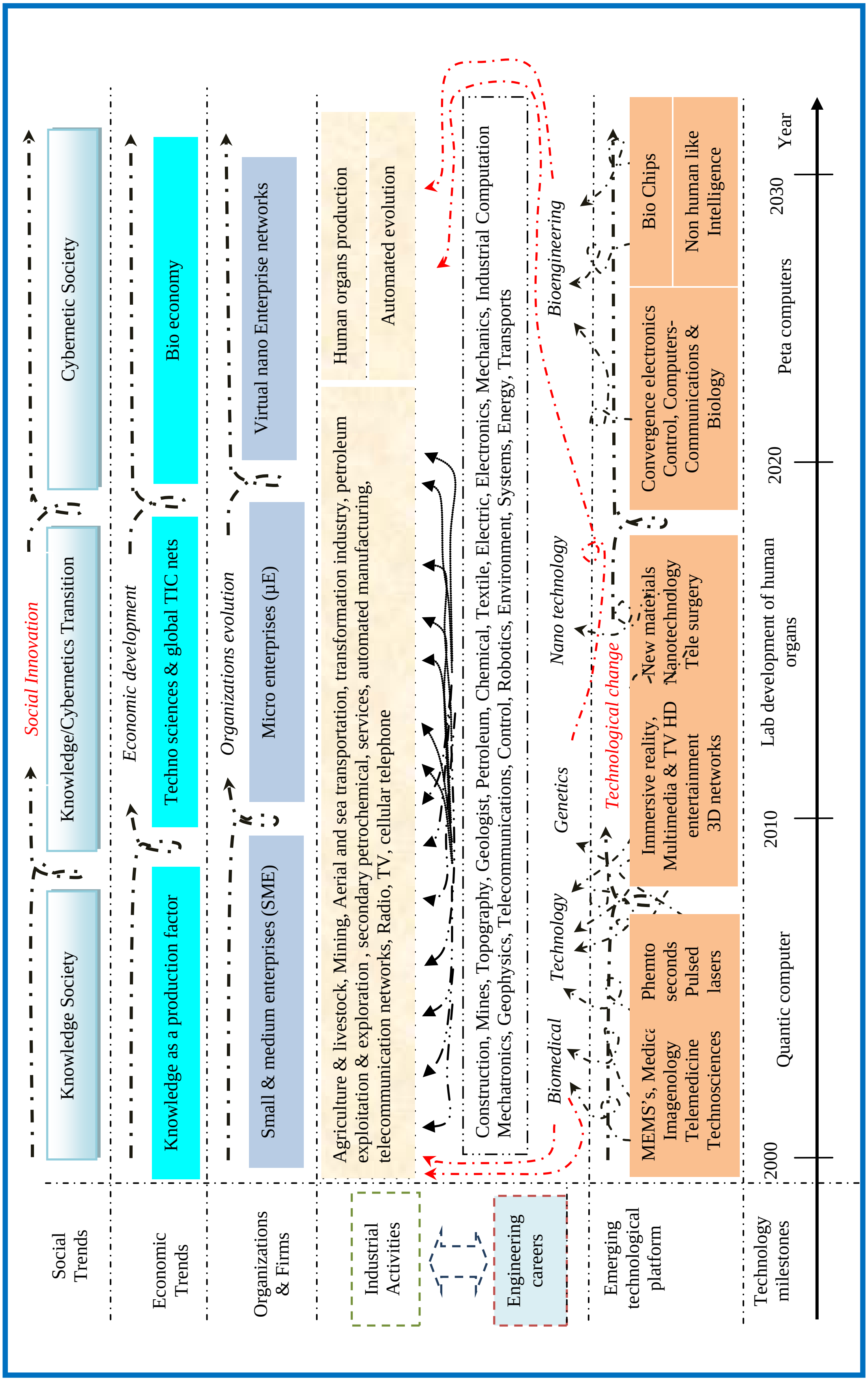

Figure 5 : Engineering careers, technological platform and social innovation (2000-2030 AC expected)

Engineers have not only backed-up enterprises and productive organizations for operating and maintaining their own technological platforms but also participate in research and development projects and working in teams with other professionals to develop an internal capacity to receive, adapt, absorb and use the big amounts of knowledge generated in and outside house.

The creativity, talents and abilities of the engineers dispersed in all the firms and organizations of the country have fostered knowledge development in the society improving indirectly the quality of life of the people and therefore pushing the society to innovate for being adapted to the technological global scenery.

Undoubtedly Mexican engineering have been a fundamental axis for the country's industrial development and for the well being of the integral society.

We envision that the dynamics of the techno-science fields will increase dramatically in next decades fostering the societal education system to find the way engineering careers form professionals capable to respond to both social needs and to the increasingly complex technological demands driving a permanent positive social change.

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Stress Increment Solution Charts for Soil Consolidation Analysis

By Muhannad Ismeik
University of Jordan

Abstract - Current practice of estimating average stress increment required for consolidation settlement computations employs mid-depth stress approach or multiple application of sublayer technique, which are tedious and difficult methods to implement for hand calculations. This paper presents simplified charts to estimate such a stress. The influence factor needed to estimate the average stress increment is calculated based on the integration of Boussinesq's equations for common foundations and various soil configurations. The results are presented in a series of normalized nondimensional charts, which are independent of structural loads and soil characteristics. The derived charts are useful especially when the compressible layer is not directly located underneath the loaded foundation and they avoid the necessity of dividing the soil into a series of sublayers to obtain a realistic value of average stress increment. They can be readily implemented into design allowing accurate prediction of consolidation settlement or can serve as a powerful tool for optimizing and proportioning the dimensions of footings under certain allowable settlement where otherwise an iterative tedious solution is required. Illustrative examples are presented to demonstrate the applicability and efficiency of the suggested charts for consolidation settlement computations.

Keywords : Consolidation settlement, stress increment, influence factor, solution charts, shallow foundations.

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STRESSINCREMENTSOLUTIONCHARTSFORSOILCONSOLIDATIONANALYSIS

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Keywords : Consolidation settlement, stress increment, influence factor, solution charts, shallow foundations.

I. Introduction

Primary consolidation is the time-dependent settlement of soil resulting from squeezing out of water from the voids, due to the dissipation of the excess pore water pressure, following the application of the load increment. The resulting settlement can be particularly large when the drainage is not impeded, but its magnitude is of engineering significance only when reference is made to a tolerable settlement for a given type of structure (Balasubramaniam and Brenner 1981). The magnitude of consolidation settlement depends largely on load and soil characteristics. Thus, a reliable settlement analysis requires accurate determination of the induced stress in the soil layer in addition to reliable consolidation parameters.

The variation of the stress produced below the foundation is non-linear in nature as schematically shown in Figure 1. The intensity of the stress decreases from a maximum value just underneath the loaded area to about zero at a very large distance from the foundation. The calculation of the stress increment in a compressible layer is commonly dealt with by the mid-depth stress approach as suggested in the literature (Terzaghi 1943; Dunn et al. 1980; Holtz and Kovacs 1981; Cernica 1994; Bowles 1995; Budhu 2000; Craig 2004; Coduto et al. 2010; Das 2010). Usually, the average stress increment of the entire soil stratum is assumed to be the one calculated at the middle of layer ignoring the non-linear variation of the stress, which may produce a substantial error.

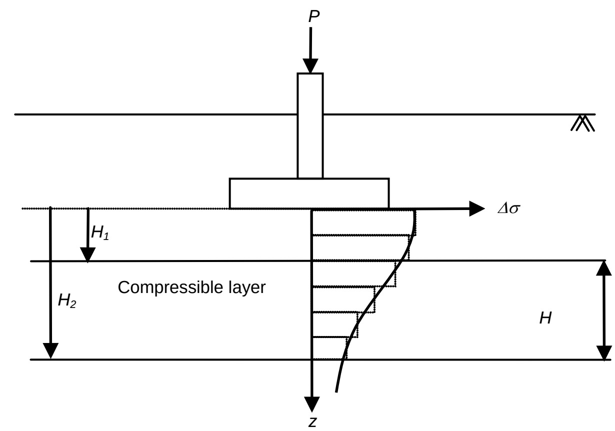

Fig. 1 : Stress increment distribution below the center of a uniformly loaded footing

Calculations of average stress increment in soil mass are improved by subdividing the soil stratum into a number of horizontal sublayers as illustrated in Figure 1. The technique involves replacing the smoothly varying stress distribution within a soil by a staircase-like distribution. The technique assumes a constant stress over each sublayer and the value at the mid-depth provides an approximation of the stress increment for every sublayer. The stress at the mid-depth of each sublayer is determined and the settlement within every sublayer is separately calculated, and then summed to obtain the total settlement. Although this multiple application of the sublayer technique is recommended in the literature, it is not widely used since it is impractical for manual computations, and the calculations are time-intensive and tedious.

The error resulting between the application of mid-depth stress approach for a soil stratum and multiple application of sublayer technique, which might be misleading and unacceptable, depends largely on the size and shape of foundation, thickness of the compressible layer and its location relative to the applied load, and the number of sublayers as

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demonstrated by McPhail et al. (2000) and Ismeik (2012). Obviously, as the thickness of sublayer decreases, the precision of the computed settlement becomes greater. However, using a large number of sublayers is not propitious to hand calculations. Thus, practically the soil stratum is usually divided into few sublayers with the intention of providing a reasonable answer with a moderate amount of effort.

II. Study Motive

Current practice of estimating average stress increment required for consolidation settlement computations usually employs conventional methods such as mid-depth stress approach or multiple application of sublayer technique, which are both tedious and difficult to implement for hand calculations. In addition, they do not consider the case where the compressible soil layer is not directly located below the loaded foundation.

This paper enables the average stress increment beneath the center of a uniformly loaded foundation to be obtained as opposed to the stress increment at a specific depth. A series of normalized non-dimensional charts are developed to estimate the influence factor of a finite soil layer based on size and shape of foundation, thickness of compressible layer, and its location relative to the applied load. Numerical examples are included to illustrate the effectiveness and applicability of the derived charts for settlement computations. A comparison is made between the results obtained by these charts and conventional methods.

III. Derivation

As proposed by Terzaghi (1943), the magnitude of consolidation settlement of a compressible layer is determined as:

$$dS = m_v(z)\Delta\sigma(z)dz \tag{1}$$

in which dS is the differential settlement due to compression of soil thickness dz, $m_v(z)$ is the soil coefficient of volume compressibility, and $\Delta\sigma(z)$ is the vertical stress increment produced below the loaded foundation at a particular depth z.

If the coefficient of volume compressibility $m_v(z)$ is taken as a constant, at least at certain depths, the total consolidation settlement S, over the entire thickness of soil stratum H, is the integration of Equation (1) as:

$$S = m_v \int_0^H \Delta\sigma(z)dz \tag{2}$$

Based on the theory of elasticity, Boussinesq (1885) provided the equations needed to calculate the stress increment $\Delta\sigma(z)$ in a soil mass. The equations consider a point load on the surface of a semi-infinite, homogeneous, isotropic, weightless and elastic half-space. The integration of vertical stress at a depth below a uniformly loaded area was originally described by Newmark (1935). Then the solutions were later improved by Steinbrenner (1936) and graphically represented and summarized by Fadum (1948), and Poulus and Davis (1974). Despite of all the unrealistic assumptions used to develop such solutions, they are still traditionally being used in the literature to obtain the stress increment $\Delta\sigma(z)$ under foundation loads.

Using Boussinesq (1885) solutions, the calculation of the stress increment beneath the center of a uniformly loaded foundation is computed as:

$$\Delta\sigma(z) = qI(z) \tag{3}$$

where q is the surface contact stress at the foundation level. I is a non-dimensional influence factor defined as:

$$I = \frac{2}{\pi}\left[\frac{mn}{\sqrt{1+m^2+n^2}}\frac{1+m^2+2n^2}{(1+n^2)(m^2+n^2)} + \sin^{-1}\frac{m}{\sqrt{m^2+n^2}\sqrt{1+n^2}}\right] \tag{4}$$

where m and n are dimensionless shape and depth factors, respectively, defined as a function of the rectangular foundation dimensions width B, and length L, as:

$$m = \frac{L}{B} \text{ and } n = \frac{z}{0.5B} \tag{5}$$

If the loaded foundation is circular, of diameter D, the influence factor I is defined as:

$$I = \left[1 - \frac{1}{\left[1+\left[\frac{D}{2z}\right]^2\right]^{3/2}}\right] \tag{6}$$

Substituting the value of stress increment $\Delta\sigma(z)$, as defined by Equation (3), into Equation (2), the settlement of the compressible soil stratum is thus computed as:

$$S = m_v q I_{ave} H \tag{7}$$

where I_{ave} is the average influence factor of soil stratum defined as:

$$I_{ave} = \frac{1}{H}\int_0^H I(z)dz \tag{8}$$

The integration of Equation (8) is commonly dealt with numerically since the influence factor I has a complex non-linear variation, which is a function of shape and size of the foundation, and depth of soil layer as given by Equations (4) and (6). Accuracy is improved when the integration is calculated over an infinite number of sublayers each of an infinitesimal uniform thickness *dz*.

IV. Results and Application

Hand calculations of the average influence factor I_{ave} of Equation (8), over a series of several sublayers, is impractical and tedious even for a single soil layer. Alternatively, a computer code is developed to evaluate the integral numerically and the results are presented graphically. The solution charts, which are independent of structural loads and soil properties, consider a relative configuration of the compressible layer H_2/H_1 ranging from 1 to 10, and common foundation types such as square ($L/B = 1$), rectangular ($L/B = 2$ and 3), strip ($L/B > 10$), and circular ones as presented in Figures 2, 3, 4, 5, and 6, respectively.

The presented charts are the exact solutions of average influence factor and they can be used confidently in geotechnical design. They enable the average stress increment, beneath the center of a uniformly loaded foundation, to be obtained directly as opposed to the stress value at a specific depth, as provided by Boussinesq's (1885) solutions. The charts, which agree well with the results of Ismeik (2012), have two powerful and practical advantages for preliminary foundation design when hand calculations are carried out, and especially if the compressible layer is not directly located below the loaded foundation. Firstly, the estimation of the average influence factor is far easier when obtained from the charts and thus avoids the use of mid-depth stress approach, which may produce a large error. Secondly, the charts can be used efficiently to optimize the required dimensions of a footing constrained by a tolerable settlement, as an alternative to classical mid-depth stress approach where an iterative method is required to find minimum dimensions.

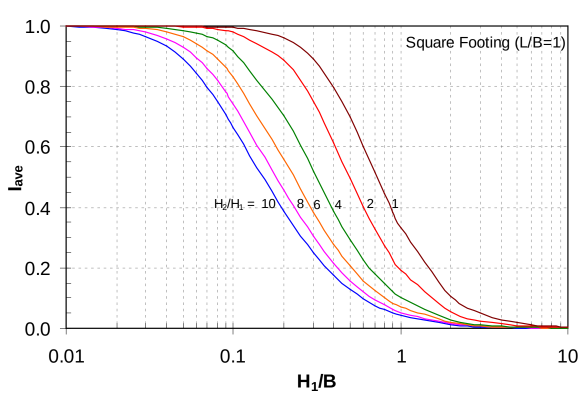

Fig. 2 : Influence factor under the center of a uniformly loaded square footing (L/B = 1)

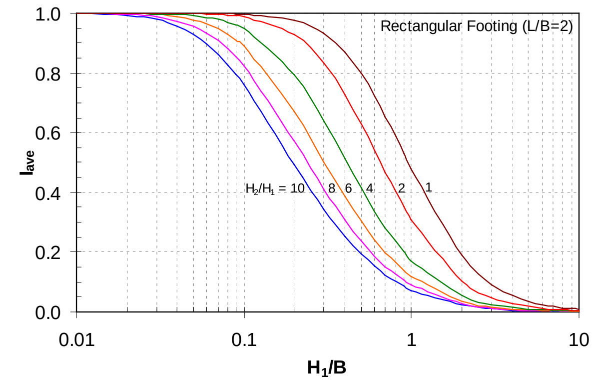

Fig. 3 : Influence factor under the center of a uniformly loaded rectangular footing (L/B = 2)

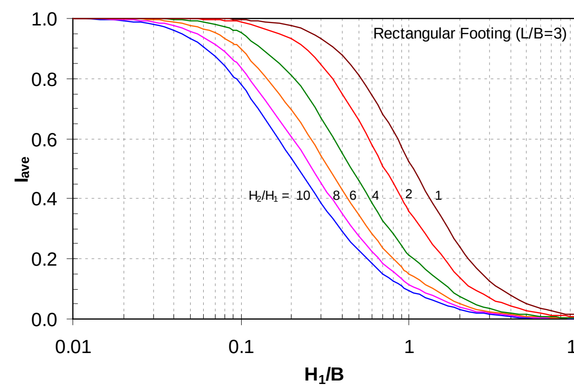

Fig. 4 : Influence factor under the center of a uniformly loaded rectangular footing (L/B = 3)

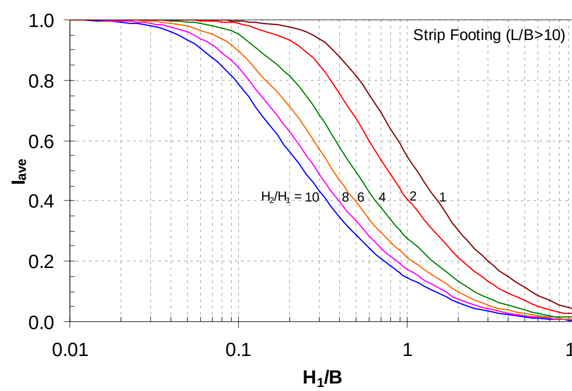

Fig. 5 : Influence factor under the center of a uniformly loaded strip footing (L/B > 10)

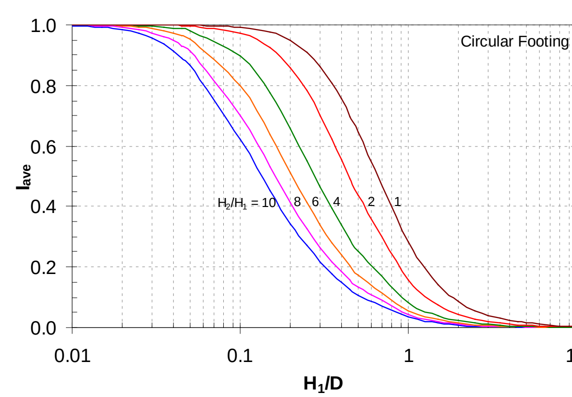

Fig. 6 : Influence factor under the center of a uniformly loaded circular footing

V. Examples

The use of the charts in settlement computations is illustrated by considering the 2 m width square footing as shown in Figure 7. The soil profile is

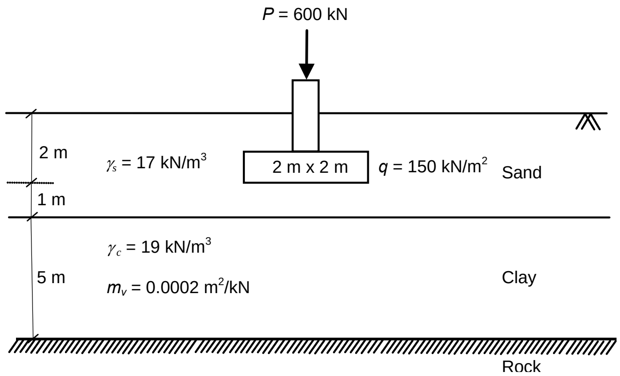

Fig. 7 : Loading and soil profile data of the examples

composed of a 5 m clay layer overtopped by a 3 m sand layer and underlain by an impermeable hard base. Soil characteristics are γ_s = 17 kN/m^3, γ_c = 19 kN/m^3, m_v = 0.0002 m^2/kN, and H_1 = 1 m, H_2 = 6 m, and H = 5 m. The structural loading values are P = 600 kN and q = 150 kN/m^2. Exact values of average influence factor and settlement are 0.2059 and 30.885 mm, respectively.

With H_2/H_1 = 6 and H_1/B = 0.5, the average influence factor I_{ave} is picked up from Figure 2 as about 0.21. Thus, the consolidation settlement is computed by Equation (7) as:

$$S = 0.0002 \times 150 \times 0.21 \times 5000 = 31.5mm \quad (9)$$

The error produced by the use of the proposed charts is about 1.99% of actual settlement, which is quite acceptable.

Had the mid-depth stress approach been used to calculate the influence factor I, for m = 1 and n = 3.5, the computations for settlement prediction using Equations (4) and (7) would be:

$$I = \frac{2}{\pi}\left[\frac{1\times 3.5}{\sqrt{1+1^2+3.5^2}}\,\frac{1+1^2+2\times 3.5^2}{(1+3.5^2)(1^2+3.5^2)} + \sin^{-1}\frac{1}{\sqrt{1^2+3.5^2}\sqrt{1+3.5^2}}\right] = 0.1371 \quad (10)$$

$$S = 0.0002 \times 150 \times 0.1371 \times 5000 = 20.565mm \quad (11)$$

Such a settlement value yields a significant error of about 33.41%, which is definitely unsatisfactory in geotechnical design. Thus, the direct use of mid-depth stress approach may provide inaccurate results and can be misleading when compared with actual settlement values. As seen, the provided charts simplified the computations and can be used confidently to predict the average stress increment with acceptable accuracy.

Another powerful application of the proposed charts would be to determine the minimum dimensions of a footing required to satisfy an allowable settlement. If design code permits a tolerable settlement of 25.4 mm (1 inch) for the above footing, the average influence factor I_{ave} can be obtained directly from Figure 2 for several trials of width B. Then the corresponding settlement is calculated from Equation (7) as shown below.

B (m)	H_1/B	q (kN/m^2)	I_{ave}	S (mm)
2.4	0.41	104.16	0.26	27.08
2.6	0.38	88.75	0.29	25.73
2.8	0.35	76.53	0.32	24.48

As seen, a foundation width B of about 2.6 m would satisfy the settlement requirement. Exact value of width is 2.642 m obtained by an iterative tedious solution of Equations (7) and (8) simultaneously. The resulting error is 1.59%, which is reasonably acceptable. Such an application of the charts saves effort and time when reliable fast values of dimensions are required by manual hand calculations.

VI. Summary And Conclusions

Solution charts to predict the average vertical stress increment needed for consolidation settlement analysis are presented based on the numerical integration of Boussinesq's solutions. A software code is developed to provide relationships between the influence factor and shape and size of foundation, thickness of compressible layer, and its depth relative to the location of applied load.

The suggested charts provide a refined estimate of the stress increment, which could only be obtained with a large number of sublayers in the routinely used multiple application of the sublayer technique. In addition, if the soil is considered as one layer system, the mid-depth stress approach may provide inaccurate results.

The presented charts can be used as an alternative to current conventional methods. They represent an efficient and powerful solution to calculate the average stress increment especially when the compressible layer is not directly located below the loaded foundation, or can serve as a useful tool for optimizing and proportioning the dimensions of footings under an allowable settlement.

The most important advantages of these charts, when compared to conventional solutions, are their speed, ease of implementation, and versatility for routine hand settlement calculations required for geotechnical design of shallow foundations.

Notation

Symbol	Unit	Definition
B	m	Width of foundation
D	m	Diameter of foundation
H	m	Thickness of compressible stratum
H_1	m	Depth to upper boundary of compressible layer
H_2	m	Depth to lower boundary of compressible layer
I	-	Influence factor
I_{ave}	-	Average influence factor
L	m	Length of foundation
m	-	Shape factor
m_v	m^2/kN	Coefficient of volume compressibility
n	-	Depth factor
P	kN	Vertical load at the center of foundation
q	kN/m^2	Surface contact stress
S	m	Consolidation settlement
z	m	Depth below the loaded area
$\Delta\sigma$	kN/ m^2	Vertical stress increment
γ	kN/m^3	Unit weight of soil
π	-	PI constant 3.141592654

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Analysis of Deep Beam Using Cast Software and Compression of Analytical Strain with Experimental Strain Results

By Kale Shrikant M., Prof.Patil.S.S. & Dr. Niranjan B.R.
W.I.T.Solapur

Abstract - Analysis of deep beam by using CAST software based on strut and tie method. As per ACI 318-05(Appendix -A). Design and casting of several deep beam using STM. Testing of deep beams in heavy structures laboratory for two point loading condition. Measurement of strain, load and deflection under controlled condition. Comparison of analytical flexure strain with experimental results.

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ANALYSIS OF DEEP BEAM USING CAST SOFTWARE AND COMPRESSION OF ANALYTICAL STRAIN WITH EXPERIMENTAL STRAIN RESULTS

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Kale Shrikant M. [α], Prof.Patil.S.S. [σ] & Dr. Niranjan B.R. [ρ]

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I. Introduction

Strut-and-tie modeling (STM) is an approach used to design discontinuity regions (D-regions) in reinforced and prestressed concrete structures. A STM reduces complex states of stress within a D-region of a reinforced concrete deep beam into a truss comprised of simple, uniaxial stress paths. Each uniaxial stress path is considered a member of the STM. Members of the STM subjected to tensile stresses are called ties and represent the location where reinforcement should be placed. STM members subjected to compression are called struts. The intersection points of struts and ties are called nodes. Knowing the forces acting on the boundaries of the STM, the forces in each of the truss members can be determined using basic truss theory. Strain obtained analytical by software was compared with strain recorded experimentally.

II. Computer Aided Strut-And-Tie (Cast) Analysis

A research programme was recently conducted to advance the STM for overcoming the aforementioned challenges. In addition to making the design and analysis process using the STM more efficient and transparent, the research aimed to extend the basic use of the STM from a design tool to an analysis tool that can be used for evaluating member behavior and there by making it possible to evaluate/validate/extend design code provisions (e.g. dimensioning rules and stress limits) of deep beam. By using a computer-based STM tool called CAST (computer aided strut-and-tie) was developed by Tjhin and Kuchma at the University of Illinois at Urbana-Champaign (2002). This tool is the subject of this paper. CAST facilitates the instruction activities for analysis of reinforced concrete deep beam by STM. This paper considers D-regions that can be reasonably assumed as plane (two-dimensional) structures with uniform thickness and the state of stress is predominantly plane (plane stress condition). Two point loading acting on the D-regions is limited to static monotonic, but can be extended to account for the degradation effects of repeated loading. Only strut-and-tie models that consist of unreinforced struts and non-prestressed reinforcement ties are considered. The primary failure modes of the D-regions are the yielding of ties, crushing of struts or nodal zones and diagonal splitting of struts. Failures due to reinforcement anchorage and local lateral buckling are not considered.

III. Analytical Modeling Of RC Deep Beam

The strut-and-tie model was analyzed using CAST software. Experimental and analytical deep beam model was having 0.7 m length, 0.4 m depth and 0.15 m thick. The materials properties obtained from material tests will used for concrete and reinforcing steel in the models. By doing so, the strength reduction factor ϕ was set to unity. The supports where modeled as a vertical reaction on the left support and a vertical and horizontal reaction on the right support The software's capacity prediction feature was used to estimate the capacity using the provided steel reinforcement, concrete struts and nodal zones.

Additionally, the software has a feature that allows analysis of the nodes to ensure that geometry and stress limits are not exceeded. The estimated capacity according to CAST, the failure would occur by yielding of the diagonal tie. This is desirable in STM because it allows the member to fail in a ductile manner as the reinforcing bars yield first before failure, as opposed to brittle failure of the concrete strut.

IV. Strut-and-Tie Method: Design Steps

The design process using the Strut-and-Tie Method involves steps described below. These steps

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are illustrated using the design example of a deep beam.

1. Define the boundaries of the D-Region and determine the boundary forces (the ultimate design forces) from the imposed local and sectional forces. Boundary forces include the concentrated and distributed forces acting on the D-Region boundaries. Boundary forces can also come from sectional forces (moment, shear, and axial load) at the interface of D- and B-Regions. Body forces include those resulted from D-Region self-weight or the reaction forces of any members framing into the D-Region.
2. Sketch a Strut-and-Tie Model and solve for the truss member forces.
3. Select the ordinary reinforcing steel and prestressing steel that are necessary to provide the required Tie capacity and ensure that they are properly anchored in the Nodal Zones.
4. Evaluate the dimensions of the Struts and Nodes such that the capacity of all Struts and Nodes is sufficient to carry the truss member forces.
5. Provide distributed reinforcement to ensure ductile behavior of the D-Region.

Since equilibrium of the truss with the boundary forces must be satisfied (step 2) and stresses everywhere must be below the limits (step 3 and 4), one can see that the Strut-and-Tie Method is a lower-bound (static or equilibrium) method of limit analysis.

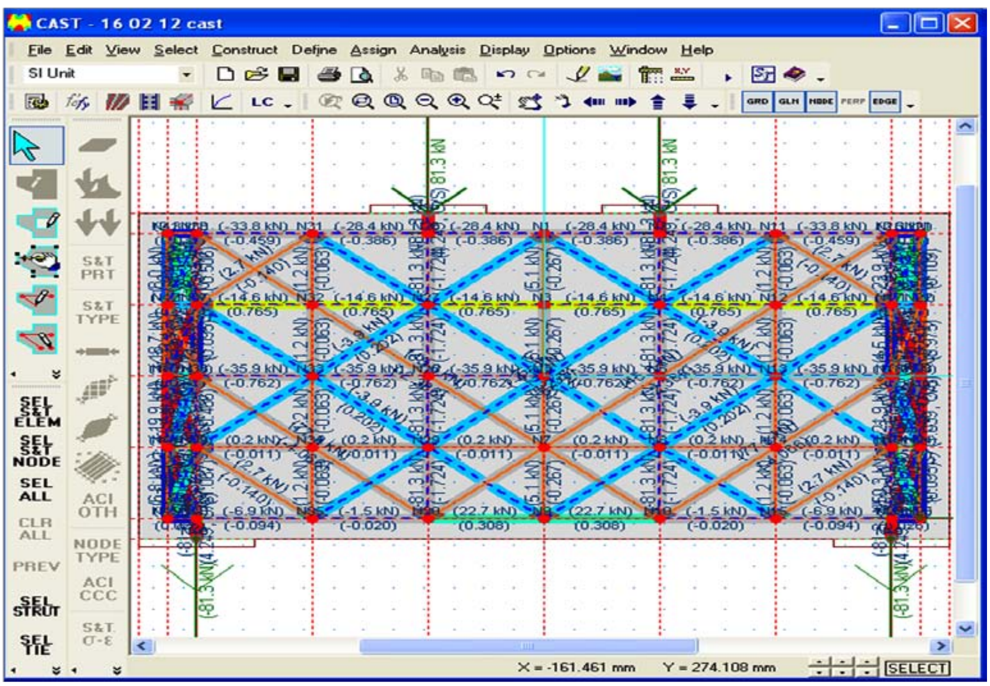


Figure 1 : Forces in members by CAST analysis

Above figure shows the forces in strut and tie developed in deep beam using CAST software similarly strain and stress are obtained in graphical as well as tabulated form.

V. Experimental Work

In experimental investigation of deep beam we have taken same size of deep beam of total length 700 mm, depth 400 mm and width 150 mm. Which were casted in concrete technology labarotaty and curring was carried out for 28 days. M25 gread of concrete were used for deep beam. For application of load we have used 1000 kN capacity hydraulic heavy testing machine. To measure deflection dial gauge where placed at central position of bottom of deep beam. to measure strain along mid span we have used strain gauge at equally spacing from top to bottom.

Figure 2 : Test setup for Deep beam

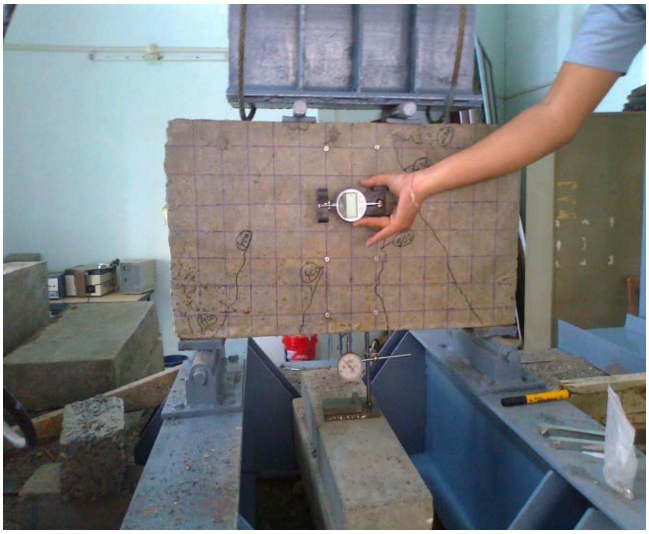


Figure 3 : Strain measurement of deep beam

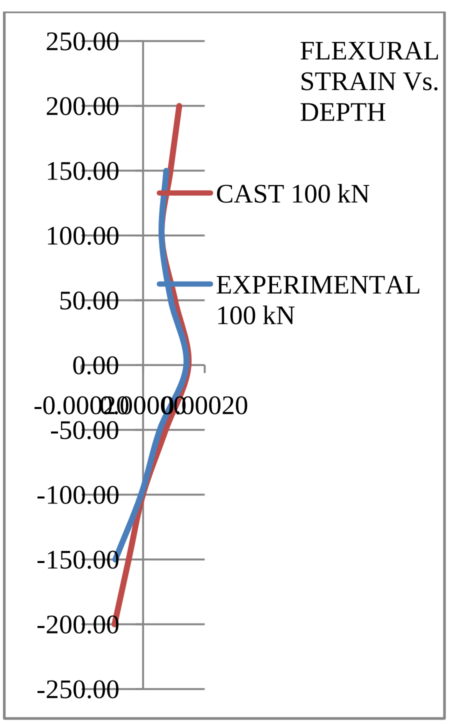
Table 1 : Experimental Strain (in mm)

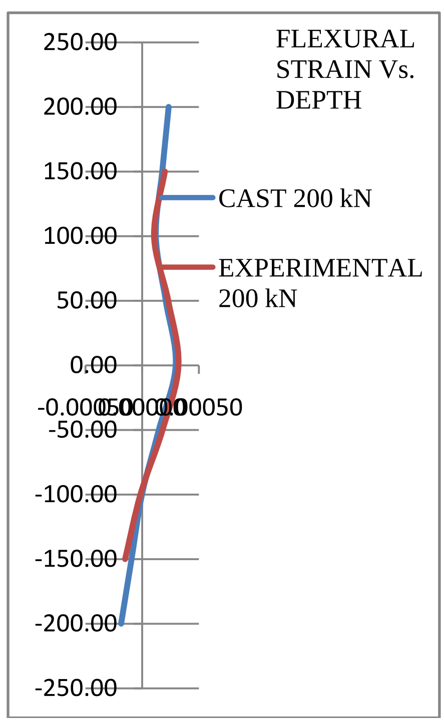
Load →	100 kN	200 kN	300 kN	400kN	440 kN
Depth ↓					
150	0.00008	0.00011	0.00022	0.00029	0.00032
100	0.00006	0.00011	0.00026	0.00036	0.00045
50	0.00009	0.00023	0.00052	0.00096	0.00121
0	0.00014	0.00035	0.00072	0.00140	0.00165
-50	0.00005	0.00019	0.00038	0.00080	0.00092
-100	-0.00001	-0.00001	-0.00002	0.00000	0.00000
-150	-0.00009	-0.00015	-0.00035	-0.00038	-0.00039

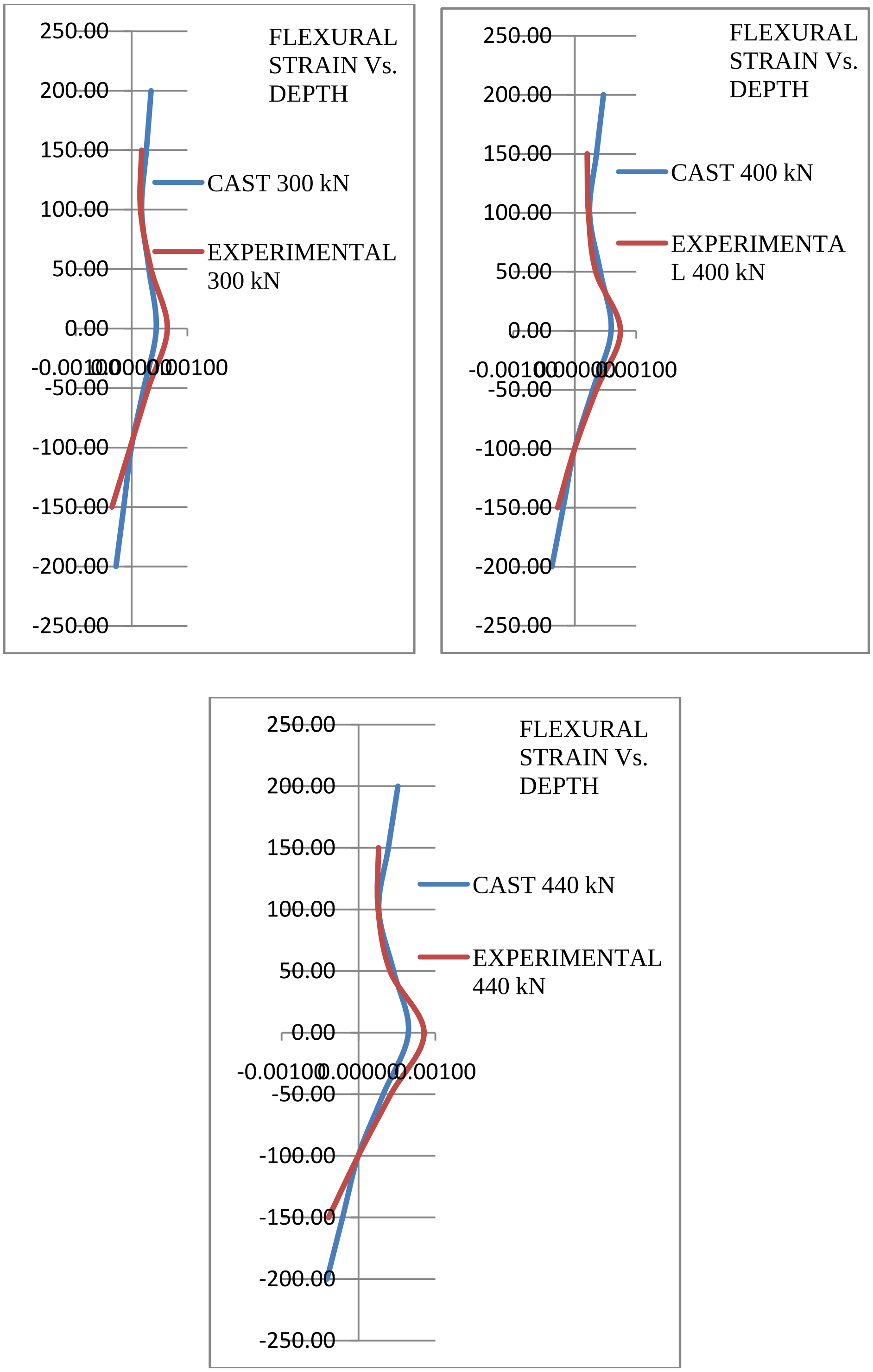
Table 2 : Analytical strain (in mm)

Load	100 kN	200 kN	300 kN	400kN	440 kN
Depth					
200.00	0.00005	0.00010	0.00014	0.00018	0.00020
150.00	0.00005	0.00010	0.00015	0.00021	0.00023
100.00	0.00006	0.00009	0.00016	0.00023	0.00026
50.00	0.00012	0.00021	0.00043	0.00071	0.00084
0.00	0.00019	0.00033	0.00070	0.00120	0.00142
-50.00	0.00011	0.00018	0.00038	0.00065	0.00077
-100.00	0.00002	0.00003	0.00006	0.00010	0.00012
-150.00	-0.00002	-0.00006	-0.00009	-0.00011	-0.00012
-200.00	-0.00007	-0.00015	-0.00024	-0.00032	-0.00036

In above table 1, shows experimental strain at mid span of deep beam at definite incremental loading at various depth to understand the nature of strain. Analytical strain obtained By using cast software are tabulated in table 2.







Graph 1 : Comparison of Flexural strain vs. depth

Above graph shows the comparison of experimental strain and analytical strains recorded at 100 kN, 200 kN, 300 kN, 400kN, 440kN. Experimentally deep beam designed by strut and tie method for two point loads of 50 kN (2 X 50 kN =100 kN) deep beam failed at 440 kN (220 kN each).Experimental and analytical results are almost same up to 200 kN (two point load each of 100 kN)

VI. Conclusion

1. Strut and tie method is useful to understand flow of stress.
2. CAST software gives good results which matches with experimental results.
3. Strain in deep beam is non linear along its vertical axis.

4. At design load experimental as well as analytical strain at mid span of deep beam matches with each other. With further increase in load, experimental strain goes on increasing at bottom and mid depth of deep beam. (Reference Graph 1)

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By Pawandeep Chahal
CMJ University

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Abstract - In this paper we define those mathematical notions and terms that are useful about ACO and the relationships between ACO and other frameworks for optimization and control. This chapter defines and discusses the characteristics of: (i) the combinatorial optimization problems addressed by ACO, (ii) construction heuristics for combinatorial problems, (iii) the equivalence between solution construction and sequential decision process (iv) the graphical tools (state graph and construction graph) that can be used to represent and reason on the structure and dynamics of construction processes.

I. Combinatorial Optimization Problems

ACO is a metaheuristic for the solution of problems of combinatorial optimization.

Instance of a combinatorial optimization problema : An instance of a combinatorial optimization problem is a pair (S, J), where S is a finite set of feasible solutions and J is a function that associates a real cost to each feasible solution, J: S → R. The problem consists in finding the element $s^* \in S$ which minimizes the function J:

$$s^* = \arg\min_{s \in S} J(s) \quad (1)$$

Hereafter only sets S with finite cardinality will be considered, even if the above definition could be extended to countable sets of infinite cardinality. Given the finiteness of the set S, the minimum of J on S indeed exists. If such minimum is attained for more than one element of S, it is a matter of indifference which one is considered.

Combinatorial optimization problema : A combinatorial optimization problem is a set of instances of an optimization problem. The set of instances defining an optimization problem are usually all sharing some core properties or are all generated in a similar way. Therefore, an optimization problem defines a classification over sets of instances. This classification can be made according to several criteria that are usually based on both mathematical and practical considerations.

Static and dynamic optimization problems : Static combinatorial optimization problems are such that the value of the mapping J does not change during the execution of the solving algorithm. In dynamically changing problems the mapping J changes during the execution of the algorithm, that is, J depends on a time parameter t: J ≡ J (s, t).

If the statistical processes according to which the costs change over time are known in advance, then the optimization problem can be stated again as a static problem in which J is either a function of the time or has a value drawn according to some probability distribution. In these cases the minimization in Equation 1 has to be done according to the J's characteristics (e.g., minimization of the J's mean value, if J's values are drawn from a unimodal parametric distribution). On the other hand, when only incomplete information is available about the dynamics of cost changes, the problem has to be tackled online using an adaptive approach.

The set of problems here labeled as "static" are actually most of the problems usually considered in combinatorial optimization textbooks (e.g., the traveling salesman problem, the quadratic assignment problem, the graph coloring problem, etc.). They can be solved offline, adopting either a centralized or a parallel/distributed approach according to the available computing resources. Dynamic problems are somehow real-world versions of these problems. Routing in communication networks is a notable example of dynamic problem: the characteristics of both the input traffic and the topology of the network can change over time according to dynamics for which is usually hard to make robust prediction models. Moreover, in general routing requires a distributed problem solving approach.

In general terms, while for static problems using a centralized or a distributed algorithm is a matter of choice, dynamic problems usually impose more severe requirements, such that the nature (either centralized or distributed) of the problem has to be matched by the characteristics of the algorithm. In this sense, ACO's design, relying on the use of a set of autonomous agents, appears as rather effective, since it can be in principle used in both centralized and distributed contexts with little adaptation.

Primitive, environment, and constraints sets : An optimization problem can be formally identified in terms of a primitive set K, an environment set E, a solution set S, and a cost criterion J defined on S. The primitive set defines the basic elements of the problem. The environment set E is derived from the primitive set K as

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a subset of its power set, E ⊆ P (K), and the solution set S is in turn derived from the environment set in terms of a family of subsets of E defined by a set of mathematical relations **Ω** among the K's elements, S ⊆ P (E) ∩ **Ω**. The set of relations **Ω**, which puts specific limitations on the way the elements in E can be selected in order to identify elements in S, is usually termed the constraints set.

The choices for sets K, E and **Ω** are not unique. Given an abstract definition of a problem, the same problem can be expressed in different ways according to different choices for these sets. One choice can be preferred over another just because it puts some more emphasis on aspects that are seen as more important in the considered context. In general, these facts raise the issue of the representation adopted to model the abstract problem under consideration in the perspective of attacking it with a specific class of algorithms. This issue is discussed more in depth in the following of this section. But before that, it is useful to make the above notions of primitive and environment sets more concrete through a few examples, and to introduce the notion of solution components which will play a central role throughout the thesis.

In order to explain in what a problem definition in terms of the sets K, E and **Ω** precisely consists of, let us consider the concrete case of two wide and quite general classes of combinatorial problems: matching problems and set problems [70], to which we will refer often throughout the thesis:

Matching problems : A matching in a graph is a set of edges, no two of which share a node. Goals in matching problems consist in finding either matching with maximal edge sets or, given that costs are associated to the edges/nodes, matching with minimal associated cost (weighted matching problems).

Matching problems in terms of primitive and environment sets : Let K = {1, 2, . . . , N} be a generic set of elements of interest, and let K be the primitive set. The environment and solution sets are derived as follows:

E = P (K)

S = {**Ɛ** ∈ E | problem constraints Ω (K) are satisfied} (2)

The expressions 3.2 mean that the solution set is directly defined in terms of subsets of K's power set. In the class of matching problems, of particular practical interest, as well as easier to solve, are those problems for which the underlying graph is a complete bipartite graph with two sets of nodes that are equal in size. Bipartite weighted matching of this type are also known as assignment problems, which are for instance the problems of assigning tasks to agents knowing the cost of making agent i deal with task j, and include important combinatorial problems like the TSP, the QAP and the VRP. Network flow problems can be also expressed in terms of generic bipartite matching. The following example shows in practice how K, E and S can be defined in the case of a TSP.

Example 1 :

Given an N cities TSP, K = {c_1 , c_2 , . . . , c_N } = {1, 2, . . . , N} coincides with the set of the cities to be visited, E=P(K) is the set of all their possible combinations, and S results from the application of **Ω** as the subset of elements in E which are cyclic permutations of size N. An alternative definition of K, E and **Ω** could consist in K being the set of pairs (p_i , c_j), p_i , c_j ∈{1, 2, . . . , N}, that is, the set of elements telling that city c_j is in position p_i in the solution sequence (notice that being the TSP's solutions cyclic permutations, the notion of position requires setting an arbitrary start city). In this case E is still the power set of K, but the syntax of the **Ω** relations is slightly different from before, S is in fact defined as

$$S = \varepsilon^k \in E, \varepsilon^k = \{(p_1^k, c_1^k), \dots, (p_N^k, c_N^k)\} \mid \cup_i \ p_i^k = \{1, \dots, N\} \wedge \cup_i \ c_i^k = \{1, \dots, N\}$$

That is, the set of pairs must correspond to a permutation over {1, …, N}.

Set problems : In assignment problems solutions can be usually expressed in terms of ordered subsets of primitive elements, while in the case of set problems there is no explicit notion of ordering. Moreover, in most of the assignment problems the solution has a predefined size, while this is never the case for set problems. Set problems are also in general characterized by an additional level of complexity with respect to the assignment ones in the sense that is well expressed by the structure of the environment and solution sets:

Set problems in terms of primitive and environment sets : In set problems, which can be further classified in set covering, set packing and set partitioning problems, the corresponding of expression 3.2 takes the following form:

E= {**Ɛ** ∈ P(K) | instance constraints Ω_I are satisfied}

S= {**Ɛ'** ∈ P(K) | instance constraints Ω_I are satisfied} (3)

These expressions point out the fact that the solution set is defined in a more complex way than in the matching case. Solutions are in this case sets of subsets of elements of the environment set, which, in turn, are subsets of elements of K. The Ω_I constraints that have been called a bit improperly "instance constraints" are defined by the actual characteristics of the instance at hand.

Instance of a combinatorial problem using a compact representation : Let C be a finite set of variables such that a solution in S can be expressed in terms of subsets of C′s elements. In particular, called X′ = P(C), S is identified by the subset of elements of X′ for which the relations in **Ω** are satisfied: S ⊆X′ ∩ **Ω**(C). Therefore, given the sets S, C and **Ω**(C), together with a real-valued cost function J (S), a problem of combinatorial optimization consists in finding the element s* such that:

$$s^* = arg \min_{s \in \{X' \cap \Omega(C)\}} J(s) \quad (5)$$

Following this representation, an instance of a combinatorial optimization problem can be also compactly represented by the triple

$$<C, \Omega, J> \quad (6)$$

The elements of C, which represent the object of the decisions of the optimization process, are called hereafter solution components.

a) Solution components

From above definition it is apparent that solution components always have a precise relationship with the primitive and environment sets. In particular, for assignment problems C coincides with K, while for set problems C coincides with E. However, here we prefer to speak in terms of solution components rather than primitive and environment sets, because of their more intuitive and general meaning of parts of which a solution is composed of:

Solution components : The solution components set C is operatively defined as the set from which a step-by-step decision process would select elements one-at-a-time and add them to a set x until a feasible solution is built, that is, until x ∈S.

According to this characterization, the notion of solution components plays a central role in this thesis, since combinatorial optimization is here framed in the domain of decision processes, and the components of a solution are precisely the step-by-step objects considered by the decisions processes. More specifically, ACO's target will consists in the learning of good decisions in the terms of pairs of components to be included in the building solutions.

Above definition implicitly implies that for each set C of solution components must exist a bijective mapping:

$$f_C : X \subseteq P(C) \rightarrow S, \quad (7)$$

such that each s_i ∈ S has a finite subset $\{c_i^1, c_i^2, \ldots, c_i^n\}$ ∈ X of solution components as preimage in X, and this preimage is unique. That is, after a finite number of decision steps, where at each step t a new component c_t is included in the set x_t, the elements in x_t∈ X are expected to map through f_C onto an element s ∈ S. The characteristics of the mapping f_C define the level of correspondence between the problem under solution and the way solutions are represented. In particular, if f_C is not anymore surjective, not all the feasible solutions are going to have a preimage in terms of a single set of components. Such a choice could rule out the same possibility of addressing the optimal solution. On the other hand, if f_C is not anymore injective, the same solution in S can be addressed by one or more distinct elements in X. Such a choice would result in a sort of blurred image of the solution set as seen from the component set, since several solutions could be seen as the same solution, making potentially difficult for an algorithm to act optimally. In general, when the mapping f_C is not anymore bijective the representation will undergo some loss of necessary information. That is, additional information must be added to a subset x ∈ X of C's elements in order to map it onto a solution.

It is clear that once a mapping f_C has been defined, solution components can be seen in more general terms as decision variables. At each solution construction step a decision variable c_t representing any convenient value is assigned. The only strict requirement consists in the fact that sets of decision variables can be eventually mapped bijectively onto a feasible solution. Since in some sense it is natural to explicitly associate decision variables to parts of a solution, in the following we will preferably use the term "solution components" instead of "decision variables".

Even if this latter would likely make clearer the intrinsic meaning of ACO's pheromone variables, which are precisely associated to pairs (c_i, c_j) of decision variables: decision c_j is taken, conditionally to the fact that decision c_i has been already issued, according to a probability value which depends on the value of the pheromone variable $\tau_{c_i c_j}$ associated to the pair of decisions. The way ACO is discussed in this thesis in terms of sequential decision processes, as well as the recent work of Chang et al. [13], where ACO, departing from the usual application to "classical" combinatorial optimization problems, is applied to the solution of generic MDPs (therefore, dealing with stochastic transitions after the issuing of a decision), strongly confirm this interchangeable view of pheromone variables as pairs of decision variables or solution components.

II. Construction Methods

ACO's ant-like agents independently generate solutions according to an incremental construction process. Therefore, the notion of construction algorithm is at the core of ACO. A generic construction algorithm is defined here as follows:

Construction algorithm : Given an instance of the generic combinatorial optimization problem in the form equation 3.5, an algorithm is said a construction algorithm when, starting from an empty partial solution $x_0 = \phi$, a complete solution s ∈S is incrementally built by adding one-at-a-time a new component c ∈ C to the partial solution.

The generic iteration (also termed hereafter transition) of a construction process can be described as:

$$x_j = \{c_1, c_2, \ldots, c_j\} \rightarrow x_{j+1} = \{c_1, c_2, \ldots, c_j, c_{j+1}\}, c_i \in C, \forall i \in \{1, 2, \ldots, | C |\}, (3.10)$$

where $x_j \in X' = P(C)$ is a partial solution of cardinality (length) j, $j \leq |C| < \infty$.

The partial solutions, that is, the set of all the possible configurations of solution components that can be encountered during the steps of the construction algorithm, coincides with elements of the environment set X′. As it has been previously noticed, the majority of these elements are such that, in general, they are not subsets of some feasible solution set. That is, without a careful step-by-step checking, the construction process is likely to end up in a partial solution that cannot be further completed into a feasible solution.

The algorithmic skeleton of a generic construction strategy is reported in the pseudo-code of the Algorithm 3.1.

1. procedure Generic construction algorithm()
2. $t \leftarrow 0$;
3. $x_t \leftarrow \phi$;
4. while ($x_t \notin S \vee \neg$ stopping criterion)
5. $c_t \leftarrow$ select component($C \mid x_t$);
6. $x_{t+1} \leftarrow$ add component(x_t , c_t);
7. $t \leftarrow t + 1$;
8. end while return x_t ;

Algorithm 1 : A general algorithmic skeleton for a construction algorithm.

It is the duty of the construction algorithm to guarantee that a sequence of feasible partial solutions, defined as it follows, is generated during the process:

Feasible partial solution : A partial solution $x_j \in X'$ is called feasible if it can be completed into a feasible solution $s \in S$, that is, if at least one feasible solution $s \in S$ exists, of which x_j is the initial sub tuple of length j in the case of sequences, or, of which x_j is a subset in the case of sets. The set of the feasible partial solutions is indicated with $X \subseteq X'$.

It is understood that a process generating a sequence of feasible partial solutions necessarily ends up into a feasible solution. The set X of all feasible sets x_j is finite since both the set S and the cardinality of the set associated to each feasible solution s_i are finite. Moreover, $S \subseteq X$, since all the solutions s_i is composed by a finite number of components, all belonging to C. Each feasible partial solution x_j has associated a set of possible feasible expansions:

Set of feasible expansions : For each feasible partial solution x_j, the set $C(x_j) \in C$ is the set of all the possible new components $c_j \in C$ that can be added to x_j giving in turn a new feasible (partial) solution x_{j+1}:

$$C(x_j) = \{c_j \mid \exists\, x_{j+1} : x_{j+1} \in X \wedge x_{j+1} = x_j \oplus c_j\} \quad (10)$$

Where the operator $\oplus$ represents the strategy adopted by the construction algorithm to include a new component into the building solution. In general, the characteristics of the sets C strongly depend on the precise form of the operator $\oplus$.

The very possibility of speaking in terms of feasible partial solutions and feasible expansion sets is related to the possibility of checking step-by-step the feasibility of the partial solution in order to take a sequence of decisions that can finally take to a feasible solution. For reasons that will be more clear in the following, we make a distinction between the components of the algorithm managing the aspects of feasibility from those specifically addressed at optimize the quality of the solution(s) that will be built. In order to check step-by-step the feasibility of the building solution, we assume that a logical device can be made available to the construction agent:

Feasibility-checking device : By feasibility-checking device we intend any algorithm which, on the basis of the knowledge of the set S and/or of the constraint set Ω, is able to provide in polynomial time an answer concerning the feasibility of a complete solution and the potential feasibility of a partial solution.

From a theoretical point of view it is always possible to find such a polynomial algorithm in the case of NP-hard problems and in all the subclasses of the NP-hard one. However, even in the case of NP-hardness, which is the most common and interesting case, to allow a practical use of the device the polynomial order should be small. Generally speaking, the computations associated to the device should be light. When this is not the case, it can result more convenient to incur the risk of building a solution which is not feasible, that can be either repaired or discarded. For the class of problems considered in this thesis it is often possible to have at hand a computationally-light feasibility-checking device. In fact, it is usually easy to check step-by-step the feasibility of a constructing solution for assignment problems like the TSP or the QAP. However, for some scheduling or covering problems, this same task can result both more difficult and computationally expensive to accomplish. Moreover, in the case of max constraint satisfaction problems this is precisely the problem. However, the point is that here we will not focus on the design of strategies for smart or optimized ways of dealing with feasibility issues. Surely this will be an important part of the specific implementations, but we assume that in some sense this is not the most important part of the story, which is, on the contrary, the optimization of the quality of the final solution output by the algorithm.

Figure 3.1 shows in a graphical way the generic step of a construction process, pointing out all the important aspects and their reciprocal relationships in very general terms. The feasibility checking device which defines the set C (x_t) of feasible expansions for the current partial solution x_t is indicate with the Ω box, to stress the role of either the constraints set Ω and/or the explicit knowledge of the solution set to accomplish this sub-task. The specific strategy of selection and inclusion of the new component ct is indicated by the decision block π. The dashe d contour lines show the actual subsets of components defining respectively the partial solution x_t and the set of feasible expansions C (x_t). The chosen component ct belongs to this last. The diagram shows the case in which a feasible solution $x_s \in S$ is eventually constructed. The decision strategy π is generically assumed as making use of at least the information contained in the partial solution in addition to C (x_t). A similar diagram will be shown for the specific case of the ACO's ant agents, in order to show the peculiarities of the ACO's design with respect to this generic one.

This issue of the feasibility of the final solution has put in evidence the fact that during a construction process the single decisions cannot be seen as independent. On the contrary, they are tightly related, since all the decisions issued in the past will constrain those that can be issued in the future. On the other hand, feasibility is only one aspect of the entire problem of building a solution. The equally, if not more, important aspect concerns the quality of the solution. It is evident that the same considerations on the dependence among the decisions apply also when quality is considered. In general, to optimize the final quality, each specific decision should be taken in the light of all previous decisions, that is, according to the status of the current partial solution. This can be seen at the same time as a constraint and an advantage: building a solution in a sequential way allows to reason on each single choice on the basis of an incremental amount of information coming from the past and also possibly looking into the future through some form of look ahead.

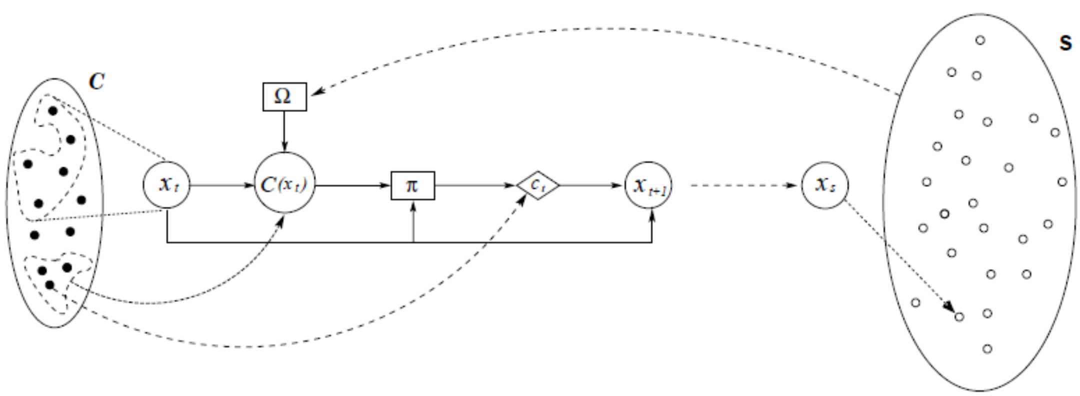

Figure 1 : The t-th step of generic construction process toward generation of a complete solution $x_s \in S$.

These are the basic key concepts to understand the rationale behind a large part of the con- tents of this chapter, which discusses construction and decision processes. In fact, in rather general terms, two construction strategies are going to be seen as different according to the different way of using and discarding the information contained in the partial solutions. In particular, it will be shown that an exact approach, like dynamic programming [3], makes use of the full information, while a heuristic approach, like ACO, drops off everything but the last included component.

III. Conclusion

In this paper we have defined the formal tools and the basic scientific background. That is, we have defined the terms and notions that will allow us to show important connections between ACO and other related frameworks and that will allow us to adopt a formal and insightful language to describe ACO.

More specifically the chapter has introduced the class of combinatorial optimization problems addressed by ACO and discussed the role and characteristics of different abstract representations of the same combinatorial optimization problem at hand. The chapter has also provided a formal definition and an analysis of construction methods for combinatorial optimization, made explicit and discussed the relationship between construction methods and sequential decision processes and, in turn, optimal control and defined the notion of construction graph as a graphical tool, derived from the state graph through the application of a generating function, which is useful to visualize and reason on sequential decision processes using a compact representation.

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Two Ways of Rotating Freedom Solar Tracker by Using ADC of Microcontroller

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Abstract - Solar trackers are used to improve electric power radically of photovoltaic panel by using different sensor. The sensors retrieve the solar radiation. This paper presents a simple method, low cost microcontroller based solar tracker of two ways of rotating freedom in order to achieve the right positioning of photovoltaic solar cell to get the much sunlight during the day light session and as a result produce more electricity. This tracking system is developed with two direct current motor operated by a PIC16F72 microcontroller which processes the sensors (LDR) information by its internal ADC-analog to digital converter with Fuzzy logic and send correct information to motor controller IC-LM392D by which motor is operated. The motor is so operated that the panel can rotates two ways such as horizontally and vertically of its direction. A comparison has been made on a conventional solar follower plant and trucking system.

Keywords : solar tracker, two ways of rotating freedom mechanism, adc-analog to digital converter, fuzzy logic, microcontroller and dc gear motor controller.

GJRE-J Classification : FOR Code : 090608, 290902

TWO WAYS OF ROTATING FREEDOM SOLAR TRACKER BY USING ADC OF MICROCONTROLLER

Strictly as per the compliance and regulations of :

Two Ways of Rotating Freedom Solar Tracker by Using ADC of Microcontroller

Sobuj Kumar Ray [α], Md. Abul Bashar [σ], Maruf Ahmad [ρ] & Fahad Bin Sayed [Ѡ]

Abstract - Solar trackers are used to improve electric power radically of photovoltaic panel by using different sensor. The sensors retrieve the solar radiation. This paper presents a simple method, low cost microcontroller based solar tracker of two ways of rotating freedom in order to achieve the right positioning of photovoltaic solar cell to get the much sunlight during the day light session and as a result produce more electricity. This tracking system is developed with two direct current motor operated by a PIC16F72 microcontroller which processes the sensors (LDR) information by its internal ADC-analog to digital converter with Fuzzy logic and send correct information to motor controller IC-LM392D by which motor is operated. The motor is so operated that the panel can rotates two ways such as horizontally and vertically of its direction. A comparison has been made on a conventional solar follower plant and trucking system.

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I. Introduction

The consumption of energy especially of electrical energy is increasing day by day in this world. Energy stored in different form in nature but the main source of energy is fuel viz. solid fuel as coal, liquid fuel as oil and gas fuel as natural gas and the Nuclear energy. But reservations of these fuels are diminishing day by day and other side Nuclear power plants are natural polluters of environment. So that, the present trend is to increase the use of renewable or alternative energy like wind, water, solar. At this moment one of the most important and attractive sources of energy is solar energy. Solar energy is paying very effective role from beginning of the world. The sun is infinite, clean energy source, no noise and free of cost and it supplies to earth about 10,000 times as much energy of the world's energy consumption [1].

So, it is time to use of solar radiation energy by converting into electrical energy or converting into our require energy forms. It is a very common problem of use of solar energy is its daily and seasonal variation of solar radiation direction. Use of solar energy is limited with sunny hours so use of it is not continuous. Therefore, as compare with the utilization of solar energy it is due to high cost and low efficiency [1]. To optimize this problem, many researchers try to inventing more effective methods of utilizing solar energy [2]. One of these methods is solar tracking system.

In Every day, the sun rises in the east, moves across the sky and sets in the west. If we could set a solar cell to turn and focus at the sun all day hours, then it is possible to receive maximum amount of sunlight and convert into more useful energy like electricity [3]. Solar module current is very sensitive to the isolation of the sun. So, small change in the radiation of the solar in the solar module makes the current drops very rapidly and at each hour, the earth rotates 15 degree about its own axis. Therefore, solar panel must rotate 15 degree every hour to follow the direct radiation of the sun otherwise output of the module will be decreased [3].

Again, during a specific local time the radiation depend on solar elevation and azimuth angle.

For a fixed panel and a mobile one, the values of global radiation, its components (direct, diffuse and reflected and the value MPP (Maximum Power Point) for the panel are reported [4-8].

We see in the city solar panel is still standing on the roof of the building and receive most of sun radiation of the midday sun[5].

In our work we develop two ways of rotating freedom solar tracker that means it can rotate both vertically and horizontal direction so that it can set with any position to aim with the sun from its own axis. Therefore it can increase its peak hours (high radiated light receiving) as consistently it can increase its efficiency. In cloudy sky, there could be a small component of direct radiation and a substantial component of diffuse radiation [9-10]. Using a trucking PV we can absorb the greatest amount of radiation as possible. The maximum radiation is obtained by providing the panel in a manner not perpendicular to sunlight, in the cases in which, for example, the sky is cloudy and the diffused component is more greater towards different directions to the "panel-sun" one [11].

In annually solar tracking system can increase 35% of its overall efficiency [1].

To develop solar tracking system, many researchers use many process. On these studies, we use analog to digital converter of microcontroller and Fuzzy logic to process the light sensor data for sun positioning for the solar tracker. In this paper shows the

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structural view, hardware and electrical view and programming system of solar tracker system.

II. Structural View Of Two Ways Of Rotating Freedom Solar Tracker System

As we know, solar panel should be directly perpendicular to the sunlight so that radiation of sunlight is highest. But, position of the sun is not same place during the whole day. Therefore, direction of the sun radiation is not same and its changes during the course of the day. So, if we can use solar tracking system it would give maximum solar efficiency [12].

The structural view of two ways of rotating freedom solar tracker by using ADC of microcontroller is shown in figure 1.

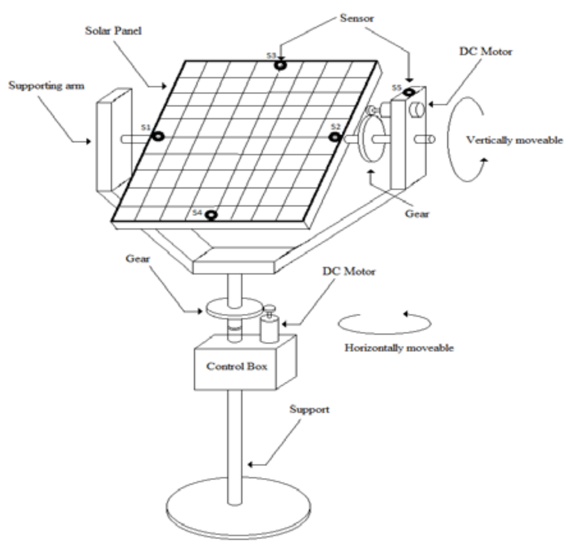

Fig. 1 : Structural view of two ways rotating freedom solar tracker.

In the system shown in Figure 1, a solar panel is mounted over the supporting arm with consisting two direct current motor with gear mechanism, five LDR (light depended resistor sensor) sensors and a control box. The light detecting system consists of five light depended resistors (LDR) which are LDR1, LDR2, LDR3, LDR4 and LDR5 represent in figure 1 as S1, S2, S3, S4 and S5 respectively mounted on the solar panel and placed in an enclosure. The sensors are setup in a way that LDR1 and LDR2 are used to track the sun horizontally for drive the horizontal positioning motor while LDR3 and LDR4 are use to track the sun vertically for drive the vertical positioning motor [13]. The LDR5 is use to detect it is day or not because only day session system will be the working mode. This sensors information is processes by using fuzzy logic because it emulates human acceptable reasoning and could make decisions on inaccurate information [14]. The all operations are operated by control box where microcontroller and motor control ICs processes whole detection and control system. So that, both motors vertical and horizontal movement to ensure proper tracking of the solar panel in any position of the sun with respect to the East-West or North-South [14].

III. The System Architecture

The system architecture of two ways of rotating freedom solar tracker system is shown in figure 2.

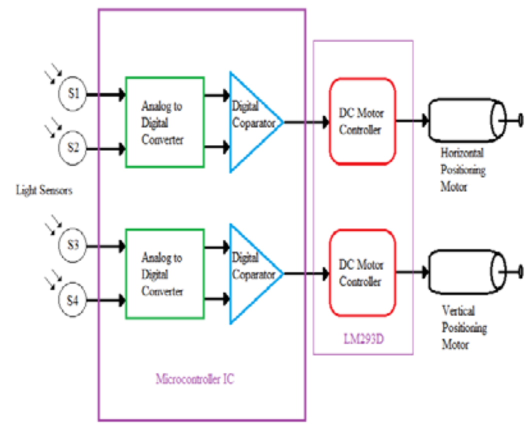

Fig. 2 : Block Diagram

The solar tracker system consists of LDRs, Microcontroller and its internal ADC (analog to digital converter), motor controller IC LM293D and direct current motor.

- LDRs detect the sunlight intensity. When consume high sunlight intensity resistance is decreased and supply high current trough it.
- Microcontroller and its internal analog to digital converter measure the LDRs supplied current and converted its corresponding digital value. This is again process by Fuzzy logic and then gives necessary signal to the motor controller IC.
- The motor controller IC of LM293D drive the DC motor by the direction of microcontroller

a) *Analog to Digital Converter*

The Analog-to-Digital Converter (ADC) allows conversion of an analog input signal to a 10-bit binary representation of that signal. This device uses analog inputs, which are multiplexed into a single sample and hold circuit. The output of the sample and hold is connected to the input of the converter. The converter generates a 10-bit binary result via successive approximation and stores the conversion result into the ADC result registers (ADRESL and ADRESH) [15].

The ADC voltage reference is software selectable to be either internally generated or externally supplied.

The ADC can generate an interrupt upon completion of a conversion. This interrupt can be used to wake-up the device from Sleep.

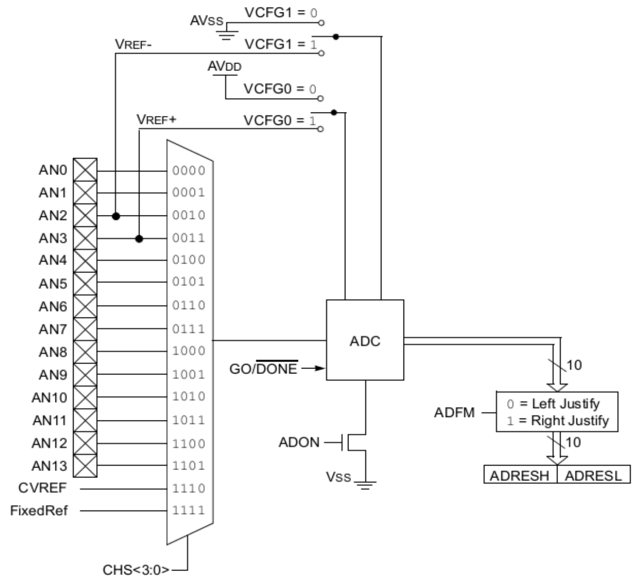

Fig. 3 : Shows the block diagram of the ADC of PIC16F72 [15].

b) *Fuzzy Logic*

Fuzzy logic is a form of many-valued logic or probabilistic logic. It deals with reasoning that is approximate rather than fixed and exact and it is very closure to the human behavior. Machines can be provided to give decisions like humans by using fuzzy logic and fuzzy cluster operations [1].

Our fuzzy logic rules for solar tracker system as follows:

	Fuzzy Logic rules
1	If S1>S2 then M1 is clockwise rotate
2	If S1=S2 then M1 is not rotate
3	If S1<S2 then M1 is anti-clockwise rotate
4	If S3>S4 then M2 is clockwise rotate
5	If S3=S4 then M2 is not rotate
6	If S3<S4 then M2 is clockwise rotate

IV. Circuit Diagram Of Solar Tracker System

The electrical architecture of two ways of rotating freedom solar tracker is shown in figure 4.

Here No.1 a voltage regulator IC LM7805 is used for constant 5V DC supply. As the system operating voltage is 12V and microcontroller is needed maximum 5V to operate. Therefore, 5V voltage regulator is used.

No.2 Sensor part, here five LDRs are used where four are used for vertical and horizontal solar tracking purposes and LRD5 is used for day or night detection purpose.

No.3 There is microcontroller IC of PIC16F72 with 4MHz Crystal and bypass capacitors. Microcontroller processes the whole control system of this circuit.

No.4 Switching part, This is basically a technique by which it control over rotating of solar panel in any direction and also initialize the solar panel position when no light is available means night. Note that we primary set the solar panel in a direction where it is start to rotate by tracking of solar. This is the initial position of solar panel. After whole day rotation the panel comes to its initial position when night.

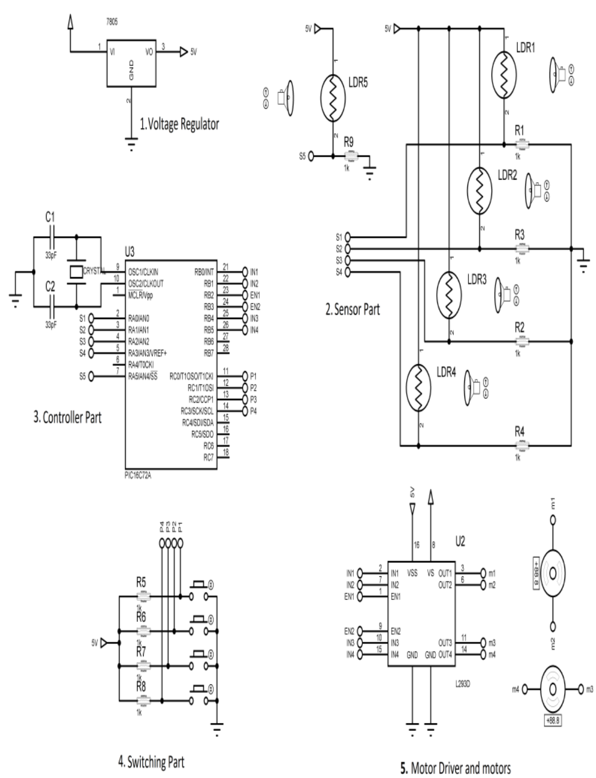

Fig. 4 : Circuit Diagram

The last part No.5 motor driver and motors, Here LM293D is used for drive the two DC 12V gear motor which is drive the rotation of 2.5Kg solar panel

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V. Algorithm For Two Ways Of Rotating Of Freedom Solar Tracker System

a. Start
b. Initialize the system.
c. Get the sensors (LDRs) analog information.
d. Convert the analog information to its corresponding digital value.
e. Compare the two pair of sensors digital values by fuzzy logic
f. Take decision for motor driver and send motor driver bits.
g. Continue the process from c to g by means continue looping.

The corresponding flow chart is given below in figure 5.

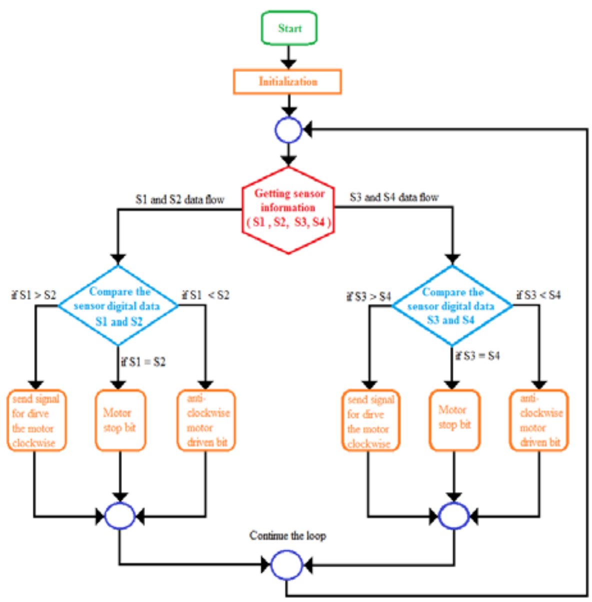

Fig. 5 : Flow chart

VI. Experimental Result

This experiment applies one solar panel where four solar cells are connected in series-parallel combination to achieve desire set of power. Then we mounted it in the roof of the IUBAT lab building and collect the data keep it on one full day light from 6 AM to 7 PM.

Table 1 : Technical details of solar panel

Brand: Toko BP Solar. Made in China		
Model No.	T-20M	
Watts Peak (W):	P(max)	20W
Short circuit current (A):	(Isc)	1.21A
Open circuit voltage (V):	(Voc)	22.5V
Maximum power current (A):	(Imp)	1.11A
Maximum power voltage (V):	(Vmp)	18V
Dimension of panel	630*290*25mm	
Weight	2.3Kgs	
AM = 1.5 ; Irradiance = 1000W/m^2 ; Tc = 25˚C		

Table 2 : Power producing of stationary solar panel and tracking panel.

Time	6	6:30	7	7:30	8	8:30	9	9:30	10
SSP	0	0.5	1	1	2	2.5	4	6	9
SPT-1	0	1	2.5	4	8	12	18	19	19
SST-2	0	0.7	2.1	3.4	7.5	12	17	18.5	19
SST-3	0	0.5	2	3.3	7.3	11	16.5	17.9	18.5
Time	10:30	11	11:30	12	12:30	13	13:30	14	14:30
SSP	12	16	18	19	19	19	18	17	16
TSP-1	19	19	19	19	19	19	19	19	19
TSP-2	19	19	19	19	19	19	19	18	18
TSP-3	19	19	19	19	19	19	19	18	17.7

Time	15	15:30	16	16:30	17	17:30	18	18:30	19
SSP	14	11	10	7	4	2.5	1	0	0
TSP-1	19	19	17	15	11	9	5	2	0
TSP-2	17.5	17	15	10	8.3	3	1.5	1	0
TSP-3	17	17	14	8	7	3	1.5	1	0

SSP = Stationary Solar Panel; TSP = Tracking Solar Panel

After calculation the all data we find that the solar system with tracking capacity give 37% of higher efficiency then its same capacity fixed angle solar system.

Fig. 6 : Practical view solar Tracker by Using ADC of Microcontroller

Simulation view in MATLAB:

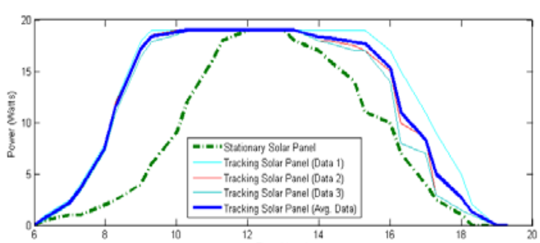

Fig. 7 : Power producing versus time of stationary solar panel and tracking panel.

VII. Conclusion

This paper depicts a solar tracking system with two ways of rotating freedom. The tracking controller based ADC of microcontroller. Set up on the solar tracking system, light depended resistors are used to determine the solar light intensity. The designed solar tracking power generation system can track the sun light automatically. Firstly data has been taken from stationary solar panel, and then from trucking solar panel during three different days. The stationary panel gives total 114.75 W power consumption per day and the average power consumption of tracking panel is 157.86 W per day. From analysis of data we get tracking panel 37 % higher efficiency then stationary panel. Although tracking system is costly than the stationary system but for long time use it will be superior to meet the future energy demand. Experimental work has been carried out carefully. The result shows that higher generating power efficiency is achieved using the solar tracker with two ways of rotational freedom.

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Nanotechnology and Its Impact on Modern Computer

By Zobair Ullah
Sam Higginbottom Institute of Agriculture

Abstract - Actually nanotechnology is a very broad area of study and research at present. It has been developed by many researchers and includes several fields of study like physics, chemistry, biology, material science, engineering and computer science. In this paper, we explore the development and advancement of nanotechnology which provides ample opportunity to develop a smaller, faster and reliable computer. In this paper, we are mainly concerned with top down approach and bottom up fabrication approach of nanotechnology that directly affects modern computer design and architecture.

Keywords : nanotechnology, nanofabrication, quantum dots, carbon nanotubes, nano design, molecular nanotechnology.

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NANOTECHNOLOGY AND ITS IMPACT ON MODERN COMPUTER

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Nanotechnology and Its Impact on Modern Computer

Zobair Ullah

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Keywords : nanotechnology, nanofabrication, quantum dots, carbon nanotubes, nano design, molecular nanotechnology.

I. Introduction

The extensive use of computer and its wide application in the modern world have forced the researchers to improve and manufacture a smaller, faster and a more reliable computer. This objective can be fulfilled by nanotechnology. Using nanotechnology we can design and manufacture electronic components and devices that can be used directly to make smaller, faster and reliable computer. According to M.C. Roco, the third and fourth generation of nanotechnology would rely heavily on research in computer science. Now, let us try to understand the meaning of nanotechnology and its implication.

II. Definition

Nanotechnology : It is defined as the engineering of functional systems at the molecular scale.

OR

Nanotechnology refers to the manipulation of matter on an atomic and molecular scale.

OR

The term nanotechnology is defined as “the design, characterization, production and application of structures, devices and systems by controlled manipulation of size and shape at the nanometre scale (atomic, molecular and macromolecular scale) that produces structures, devices and systems with at least one novel/superior characteristic or property”.

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III. Man Behind Nanotechnology

K. Eric Drexler has coined or popularised or propounded the term “nanotechnology” in the 1980’s.

IV. Objective of Nanotechnology

To built machines on the scale of molecules. Basically, nanotechnology works with materials, devices and other structures with at least one dimension sized from 1 to 100 nanometres. Examples are: a few nanometres wide--motor, robot arms, small electronic components, novel semiconductor devices and even whole computer far smaller than a cell.

V. Generations Of Nanotechnology

Nanotechnology has witnessed four generations till date.

a) *First generation of nanotechnology*

It is called passive nanostructures. Some applications are: Dispersed and contact nanostructures. Example Aerosols, colloids, coatings, nanoparticle reinforced composites, nano structured metals, polymers and ceramics.

b) *Second generation of nanotechnology*

It refers to active nanostructures. Some applications are: Bio- active, health effects, physico-chemical active (e.g.--- 3D transistors, amplifiers, actuators, adaptive structures).

c) *Third generation of nanotechnology*

It is called systems of nanosystems. Some applications are: robotics, guided assembling: 3D networking and new hierarchical architectures.

d) *Fourth generation of nanotechnology*

It is called molecular nanosystems. Some applications are: molecular devices by design, atomic design and emerging functions.

Fourth generation of nanotechnology basically deals with the manufacturing and development of nano computer.

VI. Applications Of Nanotechnology

- *Medicine* (Diagnostic, Drug delivery, tissue engineering)
- *Cryonics*
- *Environment* (Filtration)

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- *Energy* (Reduction of energy consumption, Increasing the efficiency of energy production, Nuclear accident clean up and waste storage)
- *Information and communication* (memory storage, novel semiconductor devices, novel optoelectronic devices, quantum computers)
- *Heavy industry* (aerospace, catalysis, construction)
- *Consumer goods* (Food, nanofoods, household, optics, textiles, cosmetics, agriculture and sports)

Despite, many important applications of nanotechnology, here emphasis has been given only on the area of information and communication that deals with the manufacturing and development of micro devices or electronic components required to make nano computer.

VII. Nanotechnology Techniques/Tools/Theory/Materials That Directly Affect Modern Computer

- Nanofabrication
- Quantum dots
- Carbon Nanotubes
- DNA computing
- NVRAM (non volatile RAM)
- NanoDesign (software system)

a) Nanofabrication

It is a collection of technologies which are utilised in making micro devices. Micro fabrication is the term that describes processes of fabrication of miniature structures, of micrometer sizes and smaller. For instance, fabrication of IC (Integrated circuit).Nanofabrication or micro fabrication technologies originate from the microelectronics industry and the devices is usually made on silicon wafers. Nanofabrication methods can be divided into two categories: a) top down methods and b) bottom up methods

- Top down method: It involve carving out or adding a small number of molecules to a surface. This method is generally used by electronics industry in a process called photolithography. Photolithography is the process that transfers the geometric shape on a mask to the surface of a silicon wafer by exposure to UV (ultra violet) light through lenses.
- Bottom up method: This method is used to assemble atoms or molecules into nanostructures.

In near future, the computer industry will use the above technology extensively to fabricate microprocessor chips. The microprocessor chips would be smaller, faster, reliable, efficient and lighter computers.

b) Quantum dots

Quantum dots are crystals that emit only one wavelength of light when the electrons are excited. It is a new material made by bottom up method of nanofabrication. In future quantum dots could be used as quantum bits and to form the basis of quantum computers.

i. *Working of quantum computers*

In quantum computers, the binary rate in conventional computers are repeated by quantum bits or qubits, which can be in a state of 0, 1 and superposition (simultaneously both 0 and 1). As the quantum computer can hold multiple states simultaneously, it is assumed that it has the potential to perform a million computations at the same time. This would make the computer much more faster than before. The development of quantum computer is still under research.

ii. *Limitations of quantum computer*

Since quantum computers are based on quantum mechanical phenomenon, which are vulnerable to the effects of noise, coherence disappearance and loss of quantum bits. These problems are discussed below.

- Problem of coherence disappearance: A quantum computer can only function if the information exists for long enough to be processed. The researchers have discovered that the coherence spontaneously disappears over the course of time. This could lead to a considerable problem for the development of a quantum computer.
- Simultaneous existence of two states: In a quantum computer a superconducting quantum bits can simultaneously exist in two states. Normally one of the two states disappears as soon as the system comes into contact with the outside world. The coherence then disappears as a result of the decoherence process and the information in a quantum bit is lost.

iii. *Solution to the above problem*

More research needed. There is a need to clarify the issue that molecular dynamics simulations carried out at finite temperatures of machines of some degree of complexity, in which both the mechanism itself and its mounting are subject to thermal noise.

c) Carbon nanotubes

It is a tube shaped carbon material that is measured in nanometre scales. With the advancement of nanofabrication technique, researchers used this material to create electronic components like transistors, diodes, relays and logic gates. These electronic components can be directly applied in making advanced computer.

d) DNA computing

It is an approach to nanocomputers. DNA computing uses bottom up approach or method to make DNA molecules and DNA logic gates.

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i. *Major Events*

- In 1994, L. Adleman has tried to solve a complex travelling salesman problem by using DNA computing technique.
- In 1997, researchers at the University of Rochester built DNA logic gates. This development is considered as a step towards a DNA computer.
- Researchers have found that a DNA molecule can store more information than any conventional memory chip and DNA can be used to perform parallel computations.

The above developments make the idea of DNA computing very appealing to the current researchers and scientists of the world.

Note: DNA : It is a biological term. It stands for Deoxyribonucleic acid (DNA) and it carries genetic operation for the biological development of life.

e) NVRAM (non volatile RAM)

Argonne research has developed a NVRAM (non volatile RAM) made up of tiny nano engineered ferroelectric crystals. Since the tiny nano engineered ferroelectric crystals do not revert spontaneously, RAM made with them would not be erased should there be a power failure. Using NVRAM laptop computers would no longer need back up batteries, permitting them to be made still smaller and lighter. This achievement of nanotechnology is considered as a long –standing dream of the computer industry.

f) Nanodesign (software system)

A research group at NASA has been developing a software system called Nano Design, for investigating fullerene nanotechnology and designing molecular machines. The software architecture of Nanodesign is designed to support and enable their group to develop complex simulated molecular machines. The main purpose behind developing this software system is design and simulation of materials based on nanotechnology.

VIII. Conclusion

The paper has outlined the definition and its wide application in brief. This paper is intended to describe the role of nanotechnology in the development of a sophisticated small computer. Also, the paper is intended to describe the dependency of particular section or field of nanotechnology which are directly related to the development of an advance computer in future.

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I would like to express my deep gratitude to the vast intellectual community of the world who convey their modern scientific ideas/new theory and description of new invention and discoveries in various disciplines of study through internet. These are rich source of information and greatly support research activities. At last I would like to thank the great almighty who has given wisdom, strength and knowledge to visualise and explore things from grass root level and put on papers for the benefit of mankind and promote safe invention and new discoveries.

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4. Manuscript’s Category,

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
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- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

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- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

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- If you desire, you may place your figures and tables properly within the text of your results part.

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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
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Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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