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E-News letter

June [2020], Issue 1

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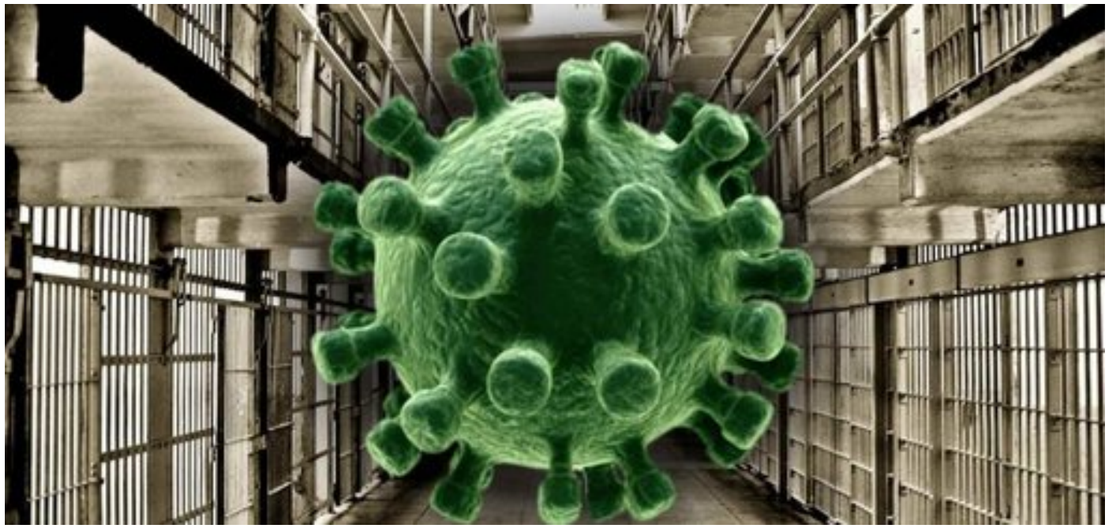
Insights

1 | Editorial Desk

Satyaban Roy



Reaching from the Editorial Desk

The *pandemic pits all of humanity against the virus. The damage to health, wealth, and well-being has already been enormous. This is like a world war, except in this case, we're all on the same side. Everyone can work together to learn about the disease and develop tools to fight it. I see global innovation as the key to limiting the damage. This includes innovations in testing, treatments, vaccines, and policies to limit the spread while minimizing the damage to economies and well-being.*

Bill Gates

[Pandemic I: The First Modern Pandemic]

Is it the best of times or the worst ? Is it the age of wisdom or foolishness ? Is it the epoch of belief or incredulity ? Is it the season of Light or darkness ? Dicken's proverbial opening sentence introduces the universal approach of his best-known work of historical fiction. And perhaps we have no other option but to begin with such incredulous but realistic questions even when we are on the platform of scientific and technological research instead of the Reign of Terror associated with the French revolution. Perhaps, we could pick up the term Reign of Terror to be identified now with the horrific virus. And Revolution to be linked with innovations in testing, treatments, vaccines etc. as indicated by the Microsoft doyen ? It is too early whether our baby Research Foundation will enter the fleet of bandwagon in such need for innovations. But as has been our declared objective of addressing industry, public, community and personalized health, health intervention using technology whenever applicable, how can we keep ourselves away from this pertinent arena of crying need. With the maiden publication of our ESRF newsletter, we are, however, sure that eminent body of ESRF in grand togetherness with merited research workers with an eye to human-centric design and engineering will leave no stone unturned in delivering their best. Our endeavor will be bridging the compartments of industry and academics leaving aside the notion of virtual barrier, if any. We believe that without such unification neither access and handling of data resource nor the process of dissemination research results will find meaningful direction. A newsletter bears the portent of philosophy and action of the concerned establishment or institution and exposes the same to the entities surrounding it. So it is implicit that it should be committed to quality and trustworthiness. It will be highly worthy to have feedback and candid suggestions from the well wishers and fellow researchers, academics and industry people from the core of their perception. Let us go ahead.

***.

Satyaban Roy
Ex-Chief Engineer, WBEDCL

2 News Room

Dr. Subhas Chandra Mukhopadhyay

FIEEE (USA), FIEE (UK), FIETE (India)
Director of International Engagement, School of Engineering, Professor of Mechanical/Electronics Engineering, Discipline Leader, Mechatronics Engineering Degree Programme,
School of Engineering (E6A 313)
Macquarie University
NSW 2109 Australia
Distinguished Lecturer, IEEE Sensors Council. and Topical Editor, IEEE Sensors Journal, Associate Editor, IEEE Transactions on Instrumentation and Measurements

Thanks to Prof. Subhas Chandra Mukhopadhyay for achieving Outstanding volunteer Award 2019 IEEE Region-10. Prof. Mukhopadhyay is associated with ESRF as Advisory Committee member. We are proud of him.

Dr. Debabrata Dutta

Former Professor Physical and Mathematical Sciences, Homi Bhabha National Institute, Deemed University, Mumbai, India.
Head (Retd.) Radiological Physics and Advisory Division, Bhabha Atomic Research Centre, Mumbai, Maharashtra, India
Advisor, Eureka Scientech Research Foundation

Thanks to Prof. Debabrata Dutta for Outstanding Awards 2019

List of Award received (2019):

- **Jalvigyan Puraskar as Best Research Paper Award – from ISH Journal of Hydraulic Engineering. Fish Shoal optimization (FSO) technique has been developed as an innovative swarm optimization intelligence computation to identify the most suitable revetment stone for design of minimum cost earthen canals which carry sediment-laden flow. FSO yielded not only the minimum cost canals but also hydraulically efficient designs with 1.32, 4.86,4.42, 4.28and 4.40 % lest costs than those obtained by other Particle Swarm Optimization Technique for five different freeboard scenarios respectively.**
- **First time in India, Molecular Dynamics Simulation has been developed in the domain of manufacturing to test the surface quality and optical quality of metal mirror. Work has been published in the ASME Journal.**

List of Research and Development made (2019):

- **Developed an Innovative Numerical Simulation of Glucose sensitive Composite Membrane Based Insulin Delivery System for Type-II Diabetic Patients.**
- **Developed Microdosimetric method for cellular level investigation of radiation protection philosophy, applicable to Cancer Patients**
- **Developed Machine Learning Algorithm and Bayesian network for water quality index computation as Big data analysis methodology**
- **Developed Fractal nature and Largest Lyapunov exponent of water quality data (Study Area covered: Karnataka state)**
- **Developed Data Mining Technique for analysis of medical image used in Mammography (An early warning to detect Breast Cancer),**
- **Designed and Fabricated Electronic Portal Imaging Device (EPID) to measure patient depth dose during radiotherapy.**

Prof. Suddhasatwa Chakraborty, Member, Executive Committee ESRF , Asst. Professor, Electrical Engineering Department, Jadavpur University has been elected as members of the following bodies in 2019 :-

- Associate Member- Division -4 : **International Commission on Illumination (CIE)**
- Member of the Electro-Technical Committee, **ETD-23, Bureau of Indian Standard (BIS)**
- Member of the Electro-Technical Committee, **ETD-49, Bureau of Indian Standard (BIS)**

Dr. Abhijit Mukherjee, Member, Executive Committee ESRF , Asst. Professor, Community medicine, North Bengal medical College & Hospitals, Darjeeling, West Bengal got Published the following research papers:-.

1. Biswas DK, Bhunia R, Mukherjee A. Prevalence of iodine deficiency disorders among school student of Purba Medinipur, 2018: a cross sectional study. International Journal of Community Medicine and Public Health. 2019 Nov;6(11):4934.
2. Chowdhury R, Mandal M, Khanra M, Mukherjee A. Nasogastric Tube Insertion in Anaesthetised, Intubated Paediatric Patients: A Comparison between Conventional Blind Method and 'Throat Pack In-situ' Technique. Journal of Clinical & Diagnostic Research. 2019 Dec 1;13(12).
3. Mukherjee A, Bhattacherjee S, Dasgupta S. Determinants of infant mortality in rural India: An ecological study. Indian journal of public health. 2019 Jan 1;63(1):27.

Mrs Bansari Deb Majumder, Member, Executive Committee ESRF , Asst. Professor, Narula Institute of Technology, Agarpara, Kolkata, West Bengal got Published the following research papers:-.

A) Journal Publications

1. Bansari Deb Majumder , Joyanta Kumar Roy , Subhransu Padhee, "Recent Advances in Multifunctional Sensing Technology on a Perspective of Multi-Sensor System: A Review" , IEEE Sensors Journal, Volume: 19 , Issue: 4 , Feb.15, 15 **2019**, pp-1204 - 1214, SCI Indexed Journal, DOI: 10.1109/JSEN.2018.2882239, Impact Factor: 3.076.
2. Bansari Deb Majumder, Atmadip Dey, Abhishek Bramha, Arka Majumdar, "Smart Blind Cane With Alarm Kit And Location Sharing System", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), Volume 14, Issue 5 Ser. II, Sep-Oct **2019**, PP 12-16, ISSN: 2320-3331, DOI: 10.9790/1676-1405021216.
3. Atmadip Dey, Arka Majumder, Raktim Pratihar, Bansari Deb Majumder, "Design of a Smart Real-time Excessive Honking Control System", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), Volume 14, Issue 6 Ser. I, Nov-Dec **2019**, PP 08-12, ISSN: 2320-3331, DOI: 10.9790/1676-1406010812.
4. Raktim Pratihar, Roberto Bhowmick, Bikram Ray, Debmalya Sadhukhan, Anuron Mallik, Bansari Deb Majumder , " Smart Agriculture Monitoring And Irrigation System Using Iot", SRN eLibrary: http://ssrn.com/link/I-I-I-Science-Engineering-Technology.html Engineering Research Network (EngRN), Proceedings of International Conference on Industry Interactive Innovations in Science, engineering and technology,13-14th December, **2019** organised by JIS College of Engineering, Kalyani.
5. Raktim Pratihar, Roberto Bhowmick, Debmalya Sadhukhan, Anuron Mallik, Bansari Deb Majumder, " Implementation of PID control Based Hybrid Model for Gesture Controlled Robotic Arm" , International Journal of Computer Science and Engineering, Vol.8, Special Issue-1, Feb **2020**, E-ISSN: 2347-2693, Open

B) Conference Publications (Bansari Deb Majumder

6. Arka Majumdar, Atmadip Dey, RaktimPratihar, Bansari Deb Majumder, "Design of a Real time Smart Honking System", Proceedings of International Conference on Frontiers in Engineering management and Applied Science , pp-31, 26-27 September, 2019 organised by Gururnanak College of Technology, Kolkata, ISBN no. 978-93-5391-015-0.
7. Ratul Saha, Sourab Ghosh, Nishita Paik, Bansari Deb Majumder, "Design of sensor-based device to detect chemicals in adulterated and counterfeited food items", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.
8. Roberto Bhowmick, Bikram Ray, Debmalya Sadhukhan, Anuron Mallik, Bansari Deb Majumder, "Hazardous Gas Detection And Control With Real Time Monitoring Over IoT", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.
9. Raktim Pratihar, Bansari Deb Majumder, "Novel Microcontroller based Vehicular Tracking System", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.
10. Ankana Mukherjee,Avinaba Bhowmick, JoydeepPatra, Bansari Deb Majumder, "Design of real-time weather monitoring system based on mobile application using weather station", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.
11. Neha Mukherjee, Bansari Deb Majumder, "Embedded System Design & Analysis", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.
12. Neha Mukherjee, Bansari Deb Majumder, "Predictive Data Analysis using Python", Proceedings of International Conference on "Future Trends and Technological Advancement in Engineering-2020" (ICFTTAE-2020), organized by the Narula Institute of Technology on 31st January and 1st February 2020.

Shri. Tanmoy Sinha Roy, Member, Executive Committee ESRF , Asst. Professor, Haldia Institute of Technology North Bengal medical College & Hospitals, Darjeeling, West Bengal got Published the following research papers:-.

Book Chapter Publications:

1.Joyanta Kumar Roy, **Tanmay Sinha Roy,** Subhas Chandra Mukhopadhyay,"*Heart Sound: Detection and Analytical Approach Towards Diseases*" ,Modern Sensing Technologies pp 103-145,Edited by Subhas Chandra Mukhopadhyay, Published by Springer Nature Switzerland AG2019,**DOI:**https://doi.org/10.1007/978-3-319-99540-3_7.

2.Joyanta Kumar Roy, **Tanmay Sinha Roy,** Subhas Chandra Mukhopadhyay,"*Heart Sound Detection and Analysis in view of Assistive Technology for Elderly* " ,Modern Sensing Technologies, Edited by Subhas Chandra Mukhopadhyay, Published by Elsevier,
DOI: 10.1016/B978-0-12-818546-9.00005-1.

Conferences:

1.Prof. Joyanta Kumar Roy, **Tanmay Sinha Roy**," *A Simple technique for heart sound detection and real time analysis",* Eleventh International Conference on Sensing Technology (ICST) 2017,
DOI: 10.1109/ICSensT.2017.8304502,ISSN:2156-8073.

2.Prof. Joyanta Kumar Roy, **Tanmay Sinha Roy**, Dr. Nirupama Mandal, Octavian Adrian Postalche, ," *A Simple technique for heart sound detection and identification using Kalman Filter in real time analysis",* ISSI 2018,International IEEE Conference on Symposium on Sensing and Instrumentation in IOT Era, IEEE Xplore, **DOI:** 10.1109/ISSI.2018.8538255.

Prof. Dr. Asis K Mukhopadhyay, Former IIT KGP professor, Member, Advisory Committee ESRF , has been appointed as Marg Darshak AICTE for mentoring AICTE Institutions for NBA accreditation.

ACADEMIC PRESS

Assistive Technology for the Elderly

2020, Pages 107-184

5 - Heart sound detection, analysis, and assistive technologies for the elderly

Joyanta Kumar Roy [1], Tanmay Sinha Roy [2], Subhas Chandra Mukhopadhyay [3]

DOI: 10.1016/B978-0-12-818546-9.00005-1

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Authors | Authors and affiliations

Joyanta Kumar Roy ✉, Tanmay Sinha Roy, Subhas Chandra Mukhopadhyay

Chapter
First Online: 25 August 2018

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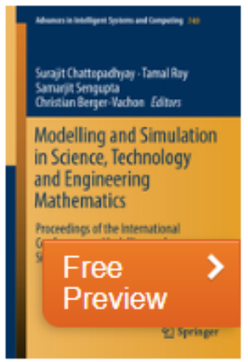
DOI: https://doi.org/10.1007/978-3-319-99540-3_7

Advances in Intelligent Systems and Computing



Modelling and Simulation in Science, Technology and Engineering Mathematics

Proceedings of the International Conference on Modelling and Simulation (MS-17)

Editors: **Chattopadhyay**, S., **Roy**, T., **Sengupta**, S., **Berger-Vachon**, C. (Eds.)

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Pages 631-639

Roy, Joyanta Kumar (et al.)

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Editors: Octavian Adrian Postolache [1] ; Edward Sazonov [2] ; Subhas Chandra Mukhopadhyay [3]
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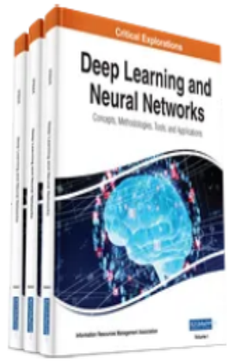

Deep Learning and Neural Networks: Concepts, Methodologies, Tools, and Applications

Information Resources Management Association (USA)

Pages: 1671
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DOI: 10.4018/978-1-7998-0414-7

PDF (/gateway/chapter/full-text-pdf/237872)
HTML (/gateway/chapter/full-text-html/237872)

Chapter 12

Artificial Neural Network (ANN) in Network Reconfiguration for Improvement of Voltage Stability (/gateway/chapter/237872) (pages 174-198)

Dipu Sarkar (National Institute of Technology, Nagaland, India), Joyanta Kumar Roy (MCKV Institute of Engineering, West Bengal, India)

Issues related to power system voltage levels have become increasingly important issue during last two and half decades. In power networks, low voltage situations may result in the loss of stability, voltage collapse and eventually...

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Technical sponsorship by ESRF

Flagship Conference of

1st International Conference on Contemporary Issues in Computing

Venue: IETE Conference Hall,Plot No J1-7, EP-Block, Sector V, Salt Lake, Electronics Complex, Kolkata
Conference Room, The Institute of Engineers, Bangladesh. Ramna, Dhaka-1000
Date: 25 - 26 July, 2020 (India) & 7 August, 2020 (Bangladesh)

INTERNATIONAL CONFERENCE ON COMPUTATIONAL INTELLIGENCE & COMPUTING (ICCIC-- 2020) JHANSI, INDIA

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EVENTS-UPCOMING (IN ASSOCIATION WITH ESRF)

Event Date	Event description	Event venue
25 - 26 July, 2020 (India) & 7 August, 2020 (Bangladesh)	1st International Conference on Contemporary Issues in Computing This International conference is Technically sponsored by ESRF. We invite you to submit an original research paper and join this conference Website: http://www.iccicstm.com/ Facebook: https://www.facebook.com/Intl-Conf-on-Computational-Intelligence-Computing-2020-Jhansi-India-102798117993351/?modal=admin_todo_tour	All day Mode: Dual (Virtual & Physical) Venue: IETE Conference Hall, Plot No J1-7, EP-Block, Sector V, Salt Lake, Electronics Complex, Kolkata Conference Room, The Institute of Engineers, Bangladesh. Ramna, Dhaka-1000
06 September 2020	ICCIC-2020 Pre-Conference Tutorial We invite you to participate pre-conference tutorial of ICCIC-2020 Website & Registration Link: http://www.iccic2020.in/index.html	All day IETE Conference Hall, Plot No J1-7, EP-Block, Sector V, Salt Lake, Electronics Complex, Kolkata
11-12 September 2020	International Conference on Computational Intelligence & Computing (ICCIC-- 2020) This is a Flagship conference of ESRF, jointly organized by Electro Inventor, SRJ Group of Institutions and IETE Kolkata. We invite you to submit the original paper and register yourself for conference participation. Website & Registration Link: http://www.iccic2020.in/index.html	All day SR Group of Institutions, Gwalior Road, Jhansi (UP)

4 Feature articles

Article-1

Application of Voronoi Diagram in Image Segmentation and CFD Analysis

Debabrata Datta

Senior Scientist-H (Retd.), Bhabha Atomic Research Centre, Mumbai, India
Adjunct Professor, Department of Mathematics,
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The partitioning of a plane with N number of points into convex polygons such that each polygon contains exactly one generating point and every point in a given polygon is closer to its generating point than to any other is labelled as a Voronoi diagram (VD) named after Georgy Voronoi, a mathematician born in Ukraine in 1868 [1]. VD (see Fig. 1.0) is also known as a Dirichlet tessellation. Mathematically, we are given a finite set of points in the plane and for each point the corresponding Voronoi cell consists of all the locations closer to it than to any of the other points. The cells are all convex polygons and called Dirichlet regions or Voronoi polygons; that is, they have boundaries made up of straight line segments and all corners have internal angles less than 180 degrees. According to graph theory, the Delaunay triangulation and Voronoi diagram in $\Re^2$ are dual to each other (Fig. 1.0).

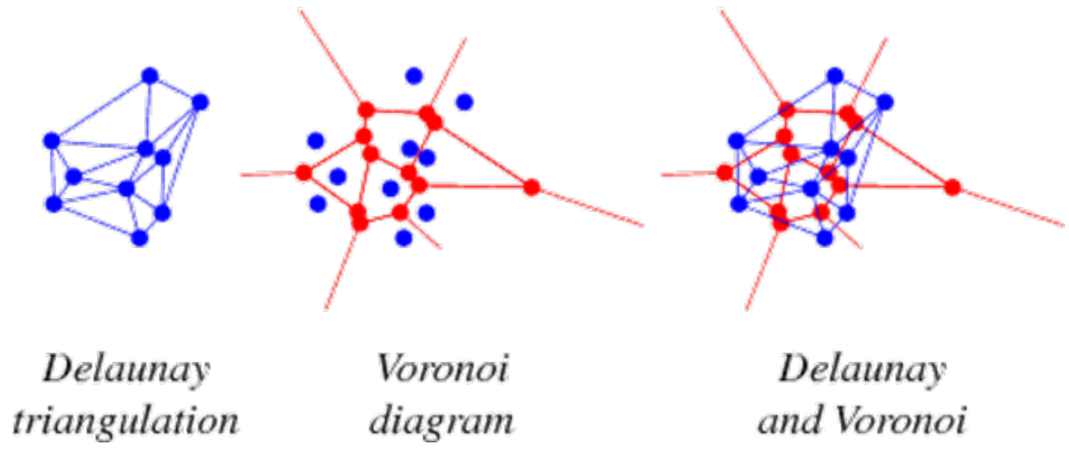

Fig. 1.0 Voronoi Diagram and Delaunay Triangulation

Here in this article, we introduce a generalization of Centroidal Voronoi Tessellation (CVT) known as L_p-Centroidal Voronoi Tessellation (L_p-CVT). The generalization structure, L_p-CVT minimizes a higher-order moment of the coordinates on the Voronoi cells and allows for aligning the axes of the Voronoi cells with a predefined background tensor field (anisotropy). Computation of L_p-CVT is carried out by quasi-Newton optimization method which is based on closed-form derivations of the objective function and its gradient. Image processing is an important task in the field of radiotherapy and diagnostic radiology (branches of medical physics). Segmentation of the target tumour or detection of edge of any image of human organ such as lung, kidney, thyroid, brain is a complicated task. In order to carry out this task efficiently, we apply computational fluid mechanics (CFD) algorithms because the complete computation falls under the physics of diffusion process (gradient based algorithms coupled with filters such as Gaussian or Laplacian). In this task, meshing of the domain of interest is carried out using Voronoi diagram. Both the surface and volume meshing are carried out using VD. Surface meshing is a triangulated mesh with per-facet anisotropy whereas volume meshing is the interior of a closed triangulated mesh with a 3D anisotropy field. In addition to the surface and volume meshing, applications to anisotropic, quad dominant surface meshing and hex dominant .

volume meshing are demonstrated with various diagrams (Fig. 2.0(a) Fig. 2.0 (b)). Lp-CVT also captures sharp features, edges and intersections.

Voronoi diagrams have applications in almost all areas of science and engineering, such as in epidemiology, geophysics, biological structures, food irradiators, blood irradiators, computer graphics and meteorology. Present circumstances of COVID-19 patients or zones can be epidemiologically identified using VD. A particularly notable use of a Voronoi diagram was the analysis of the 1854 Cholera epidemic in London, in which physician John Snow determined a strong correlation of deaths with proximity to a particular (and infected) water pump on Broad Street. In order to find the nearest hospital, surgery or supermarket and ATM centre, Voronoi diagram helps us. Voronoi diagram also helps us to develop a mathematical human phantom which is generally used for quality control and quality assurance of radiotherapuatic machine (CT, MRI). Image segmentation of cerebral aneurysm (a blood clot in human brain) has been carried out using CFD algorithm Lattice Boltzmann [2, 3] where Voronoi diagram is used for meshing the domain of interest [4].

Basically, the domain under suspect known as a map is divided into cells and each cell covering the region closes to a particular sense assists us in our quest. Biological structures can be also described using them. In aviation, they are used to identify the nearest airport in case of diversions. In mining, they can aid estimation of overall mineral resources based on exploratory drill holes. In epidemiology, they can help in identifying the source of infections. Voronoi diagrams are constructed using computer software. It can be depicted as colourful charts, indicating the region associated with each service point or site. For any location, the nearest service can immediately be read off the diagram. Software VDBIS (Voronoi Diagram Based Image Segmentation, version 4.0, Copyright BARC, 2012-2019) has been developed in BARC to carry out various image segmentation task in the field of CFD and medical physics. Some of the outcome of VDBIS for Phantom development is as shown in Fig. 3.0.

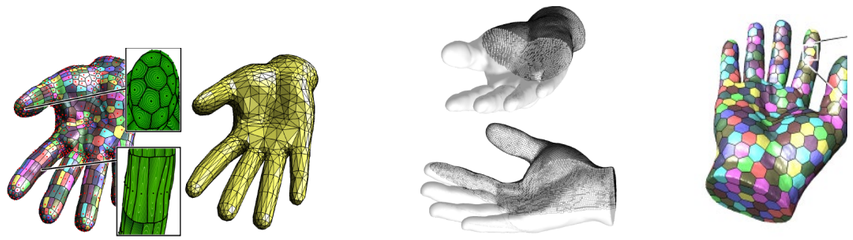

Fig. 2.0 (a) Surface Meshing using Voronoi Diagram

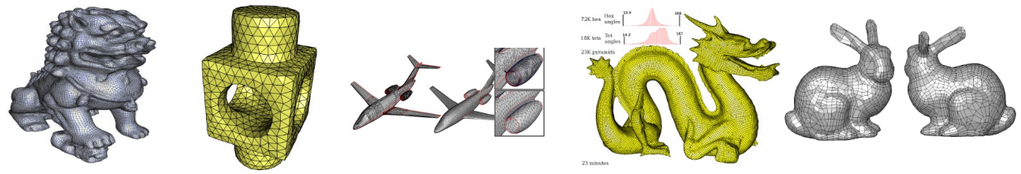

Fig. 2.0 (b) Volume meshing using Voronoi Diagram

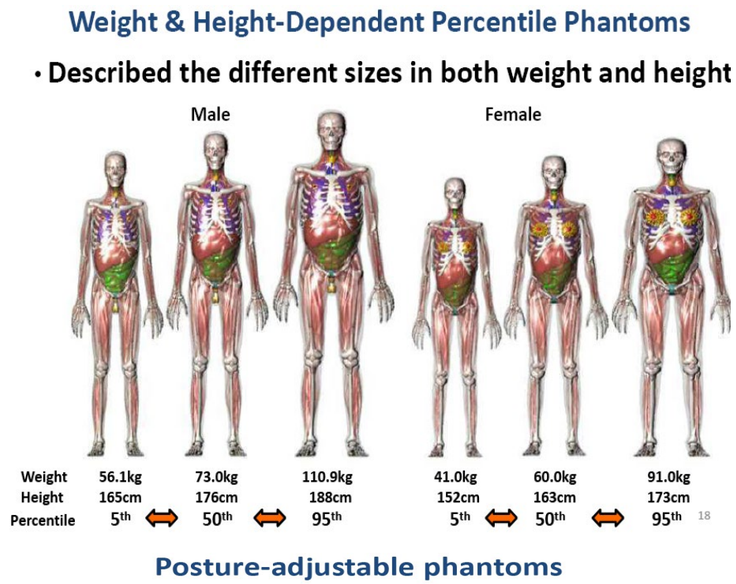

Fig. 3.0 Phantom Development using Voronoi Diagram

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1. K. Sugihara and M. Iri. “Construction of the Voronoi Diagram for ‘One Million’ Generators in Single Precision Arithmetic”, Proceedings of the IEEE, pp. 1471 – 1484. Sept. 1992.
2. Debabrata Datta, Processing of Medical Image Using Lattice Boltzmann Method Case Study: Cerebral Aneurysm Segmentation, Journal of Medical Physics, vol. 42, Issue:5, 2017, pp 1-17.
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4. Chang Q, Yang T. A lattice Boltzmann method for image denoising. IEEE Trans Image Process 2009, 18:2797-802.

4 Feature articles

Article-2

Human Centric Lighting- A path breaking step in the field of illumination Engineering

Suddhasatwa Chakraborty

Asst. Professor Electrical Engineering Department, Jadavpur University, Kolkata
Associate member-Division-4: International Commission of Illumination (CIE)
Member of the Electro-Technical Committee, ETD-23, Bureau of Indian Standard
Member of the Electro-Technical Committee, ETD-49, Bureau of Indian Standard
Convener of the panel (P/4) of Lamps and Related Equipment Committee, Bureau of Indian Standard (BIS) for revising IS 1944: Code of Practice for Lighting of Public Thoroughfare

Introduction

An eternal battle exists, regarding the definition of lighting design. Classical approach says, it is moreover engineering than "to play with" the lights. Debate still exists, and can be further inferred that both are essential components, but it is not the time to think about lighting design as a subject, rather Illumination Engineering, an interdisciplinary area with immense research potentials. It was late 90's to early 2000, when the entire focus on the Illumination Engineering came with the urge of energy saving. A global energy crunch, which the entire world must confront with. Hence, the developments of energy saving components have been inducted in this field appropriately. Energy efficient light sources, energy efficient control gears and lastly the energy efficient lighting design including day light integration and lighting control came inherently.

In Indian context, the lighting research and its application was very much concentrated on this area. But since, almost 1950'sfew global researches specially in US and Europe were started with aiming the human satisfaction and acceptance towards the lighting condition. Actually this human interference in lighting design officially reported since year 1924, when the eminent scientists Tyndell and Gibson developed Photopic Luminous Efficiency function, V(λ), which was published in Commission Internationale de l'E´clairage Proceedings. Cambridge: Cambridge University Press, 1924. Since, then Dr.Weston, Dr. Beutell, Dr.Peter Boyce, Dr.Marck Rea, Dr. Blackwell and many other scientists made continuous efforts to identify the human factors in lighting. The consistent efforts of the scientists towards integration of human acceptance as a key design parameter for lighting design, evolves todays human centric lighting approach. This human centric approach is a broader dimension of energy optimized lighting with highest degree of human performance.

Human factors in Lighting

To identify the relationship between lighting and human acceptance, it is first necessary to recognize the pathways by which lighting can affect human performance. There are three such specific pathways: through the human visual system, through the human circadian system, and through mood and motivation. Fundamentally, the visual performance is being considered as the human performance, but there are the two additional layers which govern the human performance. Figure 1clearly depicts that if the visual performance is needed to be shifted to human performance, the other routes where light can contribute, has definitely to be explored. There is a clear demarcation between visual performance, task performance and human performance. Cognitive performance takes a leader ship in task performance. Furthermore, the human circadian system is very much influencing along with the mood and motivation towards better human performance.

Several studies have been attempted towards investigations of human performance under lighting condition since last 50 years. Fundamentally the approaches can be assessed with two quality parameters e.g. face validity and generality. Table1. depicts how the studies can be explained for the face validity and generality point of view.

Table-1

Type of approaches/ studies	*Face Validity*	*Generality*
Real Task Studies	High	Very Low
Laboratory Simulation based studies	Moderate	Low
Analytical approach towards developments of a model	Low	Very High

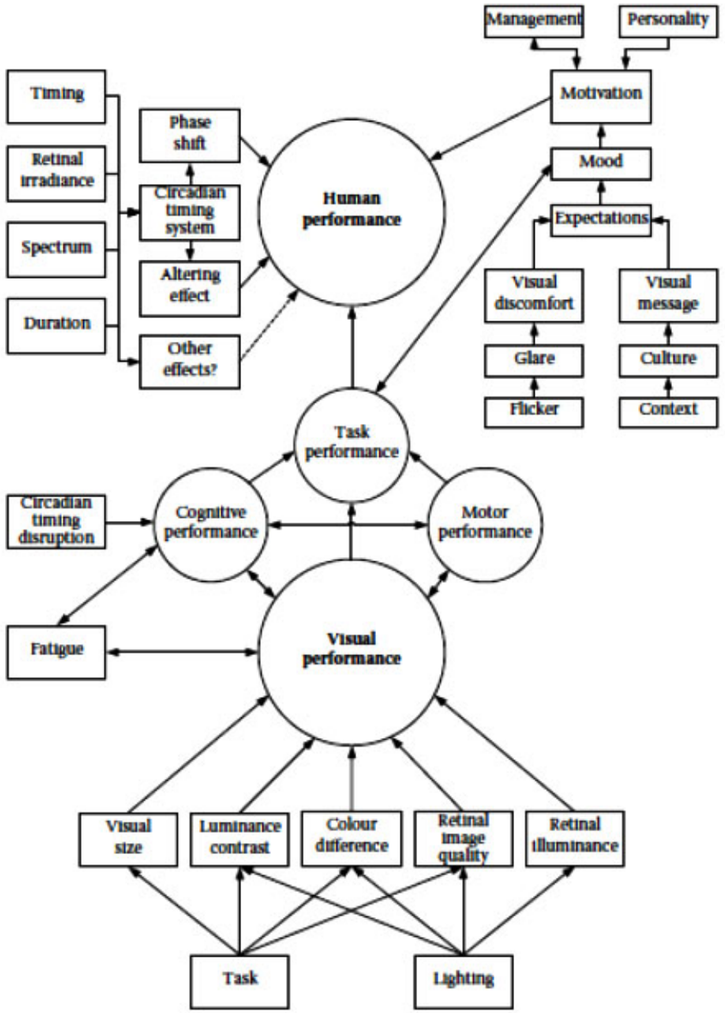

Figure 1: The path ways of lighting

The lumen realized in a light

In 1995, Robert Boynton gave the Frederic Ives Medal lecture – History and current status of a physiologically based system of photometry and colorimetry. In his talk, it was a brilliant overview of the history and technical foundations of photometry and colorimetry. In his lecture he assumed that the photometry, colorimetry and human vision should be homologous. He developed a series of arguments for 'improving' both photometry and calorimetry based upon evidence from a suite of multidisciplinary experiments in the field neuroscience. Though this homology between photometry, colorimetry and human vision doesn't directly exist, but this lecture generates a view, that, human perception towards photometry and colorimetry should be a significant point to be considered.

Since 1924 and until recently, the photopic luminous efficiency function, V(λ),has been considered the sole spectral weighting function for quantifying light or, more formally, for quantifying luminous intensity, incandelas. V(λ), which has a peak efficiency at approximately 555 nm, does not, however, accurately represent what it was intended to do in 1924, namely to characterize the 'human eye's visual sensitivity' to electromagnetic radiation. Based upon a subsequent, large body of neuroscience research, we now know that V(λ) only approximates the spectral sensitivity of just two of the five photo receptor types in the retina and, thus, does not fully characterize the spectral range of human visual (and non-visual) sensitivity to electromagnetic radiation. For this reason, a much broader universal luminous efficiency function as shown in Figure 2[U(λ)] based upon the spectral sensitivity of all five photoreceptors in the human retina is proposed here to be used for the quantification of light. Like V(λ), U(λ) is bounded at the long-wavelength end by the spectral sensitivity of the long-wavelength sensitive(L) cone. Unlike V(λ) which is bounded at the short-wavelength end of the spectrum by the spectral sensitivity of the middle-wavelength sensitive (M) cone, U(λ) is bounded at the short-wavelength end of the spectrum by the spectral sensitivity of the short-wavelength sensitive (S) cone. By replacing V(λ) with U(λ), the full range of the human retinal sensitivity to electromagnetic radiation is more accurately represented. Moreover, because U(λ) brackets the spectral sensitivity of all known photoreceptors, it also includes the full range of non-visual responses to light

generated by the human retina. These proposed efficiency function is based upon basic research into the physiological and behavioral responses of the human visual and non-visual systems to electromagnetic radiation incident on the retina.

Figure 3.clearly depicts the spectral sensitivity of different cones, rods and Intrinsically photosensitive retinal ganglion cells (ipRGCs) with 380nm-780nm band.

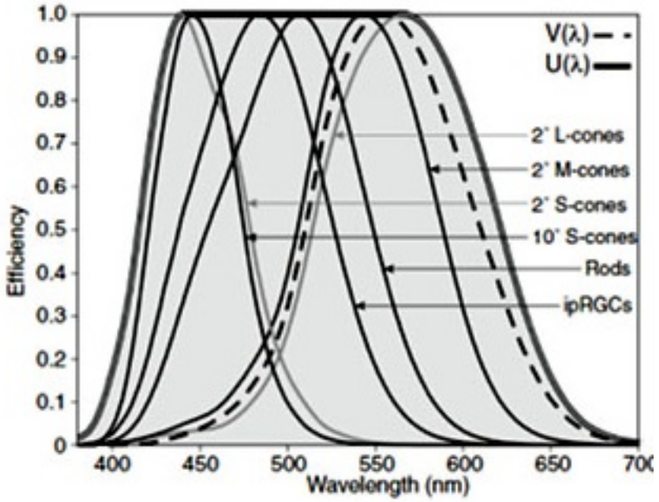

Fig. 2.

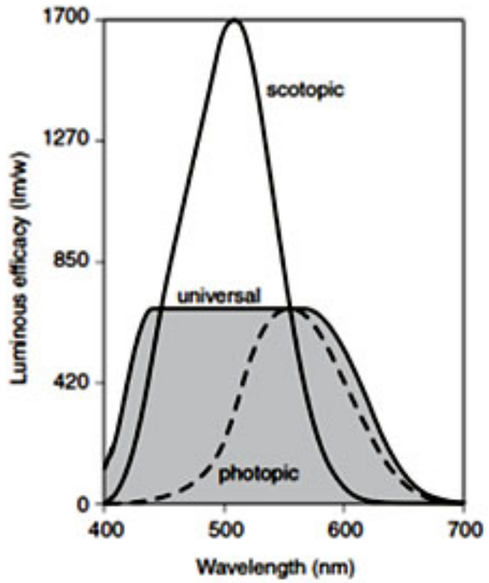

Fig. 3.

Human Centric Lighting

Fig. 2.0 (b) Volume meshing using Voronoi Diagram

All the previous experimental studies have already proven that human factors should mandatorily be included in lighting. The previous trends of energy efficient lighting design has now been shifted towards human centric lighting with energy efficient approach. As mentioned previously, lighting can contribute to human performance, not only from visual acceptance point to view also from circadian route, motivation and mood. Hence, it is a proven fact that, spectrum color and intensity of light definitely influence human performance.

The human centric lighting proposes the proper use of dimming and CCT shifting, which is termed as Kelvin Shifting, can improve circadian rhythms, mood, visual acuity and finally visual performance. Very recently Human Centric Lighting Society has been formed in US. The concept of human centric lighting evolved little lately, specially with the evolution of LED based lighting. As the LED based lighting systems are easy tunable, i.e. it can be dimmed or color can be changed instantly, hence, the image forming and non-image forming effect of light on human performances are thoroughly being investigated as well as implemented easily today. Figure 4 and Figure5,6,7show the setup of Illumination Engineering Laboratory at Technical University of Berlin, Germany for different human centric lighting related research.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

An approach for measurement of influence of lighting in human performance using EEG

Human cognition under lighting conditions present a complex yet scarcely investigated scenario. Added to this is the colour appearance of streetlights such as metal halide (MH) and high pressure sodium vapour (HPSV) lamps. As a result even simple object detection becomes highly complex. In the mentioned research work as done by the author EEG (Electroencephalogram) has been used to compare the object detection ability of human participants under MH and HPSV. The results suggest distinct brain activations for MH and HPSV. The outcome of this research opens up a new avenue, for assessment of human performance under different lighting conditions. Brain lighting to road lighting: perception matters is the research paper, published by the author says more clearly about the procedures.

Conclusion:

This review paper clearly indicates that, the recent trend of research in the field of illumination engineering has been shifted in to a different dimension, i.e. human centric lighting. The development of the new generation solid state lighting products e.g. LED, has intensified this trend of research. The rapid advancement of Internet technology has also added another dimension on this human centric lighting. This internet data can be used to control the intensity and color of light based upon the requirement in real time. Furthermore, a new domain of research has been proposed by the author here which can be used to identify the influence of lighting on human performance .This technique can be used as future metric for measurement of human perception under different lighting conditions.

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Fig.1: Covid & Environment

4 Feature articles

Article-3

Pandemic and Energy options: Home and abroad

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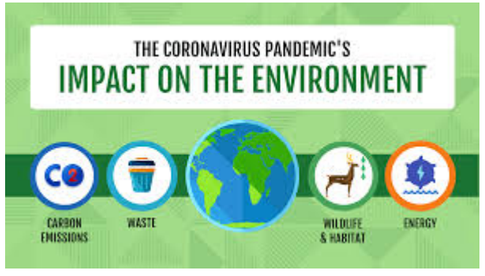

The invasion of COVID-19 pandemic has shaken energy markets to the core and threatens to push the global economy into an unprecedented recession. Amid widespread demand destruction, the price of Brent crude oil which is most traded of all of the oil benchmarks, and is defined as crude mostly drilled from the North Sea oilfields, has fallen to around $30 a barrel. The pandemic is only enhancing the earlier-observed trends in the market. So the issue transpires whether India needs to assess its energy options. The COVID-19 pandemic and lockdown puts India's energy model at risk. The pandemic is likely to impact India's ongoing energy transition – though it is too early to predict whether it will shift or pause the trajectory or induce radical change. We cannot declare for sure what the "new normal" will be for, in India or other countries. In the words of Fatih Birol, the IEA Executive Director: "It is still too early to determine the longer-term impacts, but the energy industry that emerges from this crisis will be significantly different from the one that came before."

Consequent upon the invasion of pandemic, the immediate challenge is financial liquidity with the estimation that annual losses of power distribution companies is going to double. Thus crunch of cash will put harder hurdles before new investments. India's recent energy generation investments

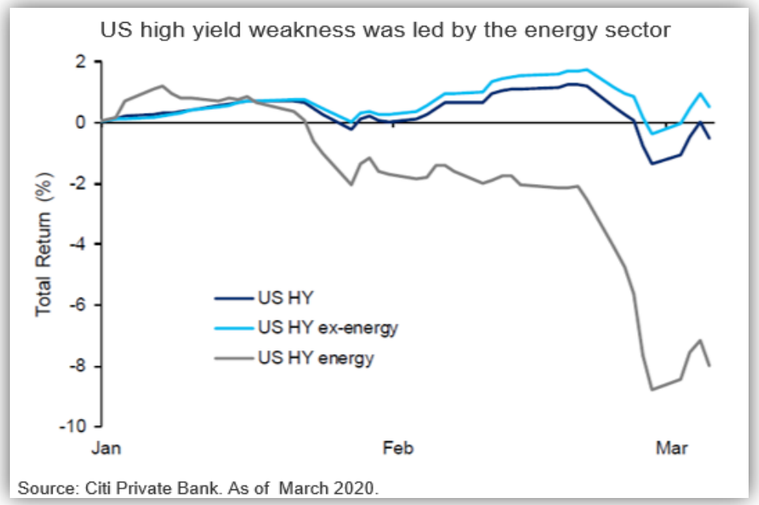

Fig.1: Covid & Environment

So far the trends in oil market go, the United States is the leading oil producer having become the largest oil exporter in the last 5 years. Since 2008 its crude oil production has sprung up by 160% enhancement while its domestic demand has shown more or less fixed figure. Since 2017, our country has increased import of crude oil from USA ten times. The giant producers of oil agreed on production cuts after considerable effort while Russia and Saudi Arabia agreed such cuts only when the pandemic took hold. This affected global demand without contributing any substantial difference to the price. Given such structural changes, it arises whether Government of India should recast the country's energy mix.

TWO ISSUES: As evident from the title, my points of discussion Centre round **two issues** – the **perspective** and the **prospects & challenges** of hydro option. How far it is an **enviable option** even within the ambit of all sorts of myth and reality associated with commonly uttered phraslogy of cheap power, peaking power, clean power?

LGBR: As per this LGBR prepared by CEA for the year 2019-20, the country is likely to experience **energy surplus of 5.8% and peak surplus of 8.4%.** State-wise power supply position shows that most the states/UTs would be having surplus energy, and the remaining few states/UTs (e.g., Assam, Bihar, Jharkhand, J&K, Uttarakhand) would need to arrange additional power from them to meet their peaking and/or energy shortages.

ENERGY SCENARIO: What is the **Present Energy scenario** in India?

- India ranks 81 position in overall energy self-sufficiency at 66% in 2014. The production and consumption of electricity in India is the third biggest after China and USA with 5.5% global share in 2016.

- About 70% of India's electricity generation capacity is from fossil fuels. India is largely dependent on fossil fuel imports to meet its energy demands – by 2030, India's dependence on energy imports is expected to exceed 53% of the country's total energy consumption.

- By the 12th Plan Year (2012-17), India has become a power surplus country with huge power generation capacity idling for want of electricity demand. But still there remains peaking shortage which remains to be bridged.

- All India per capita consumption of Electricity is nearly 1,122 kWh during the financial year 2016-17 which is low compared to many countries despite cheaper electricity tariff in India. Of course per-capita carbon emissions is also low.

SURPLUS: Despite low electricity per capita consumption in India, become a power surplus country with huge power generation capacity idling for want of electricity demand by the 12th Plan Year (2012-17).

EXPORT PROSPECTS : India has been exporting electricity to Bangladesh and Nepal and importing excess electricity in Bhutan. India can supply its surplus electricity to Pakistan and Bangladesh and Myanmar in return for the natural gas imports by gas pipe lines.

These countries are producing substantial natural gas over and above their need. Similarly India can develop on BOOT basis hydro power projects in Bhutan, Nepal and Myanmar. India can also enter into long term power purchase agreements with China for developing the hydro power potential in Brahmaputra river basin of Tibet region. India can also supply its surplus electricity to Sri Lanka by undersea cable link. There is ample trading synergy for India with its neighboring countries in securing its energy requirements.

Table-1: Total installed Power generation Capacity (end of March 2020)

Source	Installed Capacity (MW)	%
Coal	198,524.50	53.64
Hydroelectricity	45,699.22	12.35
Renewable energy	87,027.68	23.51
Natural Gas	24,955.36	6.74
Lignite	6610.00	1.79
Nuclear	6,780.00	1.83
Oil	509.71	0.14
Total	370,106.46	100

OPTIONS?

In the above backdrop, what are the OPTIONS?

So far as Energy options are concerned we have been confronted with many choices in the perspective of different courses of time during last 3 or 4 decades.

More than often it has come in the form of **CONVENTIONAL vs NON-CONVENTIONAL** sources in the context of dwindling resources of fossil fuels.

Following very infamous NUCLEAR PLANT massacre of 3-MILE ISLAND in USA and CHERNOBYL in the erstwhile USSR or more recently the FUKUSHIMA plant disaster in Japan, the question of **PRO-NUKE** and **ANTI-NUKE** have been a very common binary in energy questions. Many of the western countries have declared gradual phasing out of nuclear power sources while deciding NO for new ones. So much so that apart from the nuclear weapon, even the very OBJECTVE of safe and cost-friendly and fossil fuel-competitive image of Nuclear Electricity was put before questions.

I can recall the early period of 1980 when we were outgoing students of M.Tech. in Calcutta University, a booklet of about 30 pages came to in our hands. Authored by Prof. Martyn Ryle, the 1974 Nobel Laureate in Physics from UK. Here, Prof. Ryle had worked out a detail financial balance sheet on Asset and Liabilities of Nuclear Electric Plant, for so called peaceful use of atomic power. In the analysis it was shown cost of nuclear electricity can never be cheaper with respect to that of fossil fuels unless great value in terms of money is assigned to the bye product PLUTONIUM which stands for the raw material of Nuclear bomb. This is another angle of questioning the enviable option of nuclear electricity, the welfare myth of nuclear power. Of course, there are counter arguments too. The debate continues and will continue. Nevertheless, there are further issues like disposal of nuclear waste which is yet to have a balanced and full-proof solution.

Between Conventional and Non-conventional resources there have been very specific choices between Thermal and Hydro.
On hydro, there are Pump storage Plant and Conventional Hydro.

For, the latter there remains very confronting issues concerning DAM or NO DAM inviting ecological and rehabilitation questions.

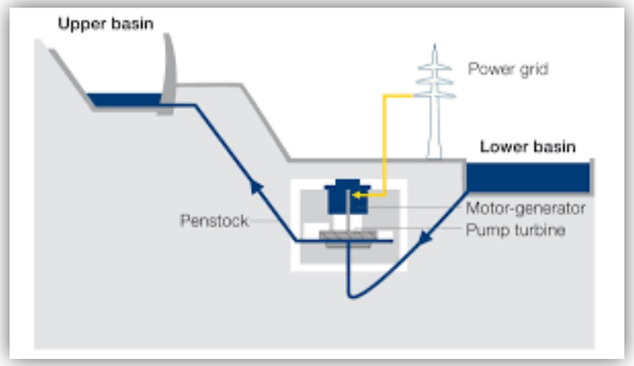

Fig.3: Pump storage scheme

In addition to all those mentioned, there remains to be decided between New Plant and going for R&MU option of running plant – Renovation, Modernization and Uprating which may be partial solution to combat energy shortage.

Now in the above stated brief overview, let us look back to HYDRO being specific to our country and then our state

HYDRO-FAVOURITE: For a state like India, there has always been a strong case for Hydro. Its relevance is even greater today than, say, 10 years ago. CLIMATE CHANGE issues, the growing PAUCITY of FOSSIL FUELS, the FLEXIBILITY IN SYSTEM OPERATION that hydro ensures, and the INFLATION-FREE COST OF GENERATION that reduces with time, all favour hydro generation.

INDIAN HYDRO-SCENE TODAY

- Economically exploitable and viable hydro potential as assessed :
- The hydropower potential of India is around 1,45,000 MW and at 60% load factor, it can meet the demand of around 85, 000 MW. Around 26% of Hydropower potential has been exploited so far.
- Assessed Small Hydro Potential (Station Capacity up to 25MW) : 6800 MW
- Identified Pumped Storage Schemes of an aggregate installed capacity of 94,000 MW at 56 sites
- India ranks 5th in terms of exploitable hydro-potential on global scenario
- The installed capacity of hydro power is 45,699.22 MW as of 31 March 2020. This excludes the SHPs (Small Hydro Power, below 25MW Station Capacity) which are covered within Renewables
- India ranks 6th in hydro electricity generation globally after China, Canada, Brazil, USA and Russia.

Type / Sector	Target	Achievement	Achievement %
Thermal	72,340	91,730	126.8
Hydro	10,897	5,479	50.28
Nuclear	5,300	2,000	37.74
Total	88,537	99,209	112.05

Source: CEA

Table 2: Capacity Addition Targets & Achievements in 12th Plan

WITH THIS SCENARIO TO EXAMINE WHETHER THERE IS SCOPE OF COMPLACENCY ON HYDRO DEVELOPMENT

WHY THIS SHORT FALL OF 50% FOR HYDRO?

Although capacity has steadily increased, its development has lagged well behind thermal generation capacity, leading to a consistent decline in its share of total electricity output in last 3 or 4 decades from 44% in 1970 to 15% in 2017.

GOVT. ACTION: Starting from 1998 when an exclusive policy for hydro development was announced, a lot has changed in last two decades, in terms of ground work on policy, awareness and R&R issues.

In May 2003, the Prime Minister's 50,000 MW Hydro initiative was launched. Over the years, the time cycle for clearances has considerably been reduced; For instance TEC from CEA is now required only in special cases.

Further, the National Policy on Resettlement & Rehabilitation for Project-Affected Families, 2003 has lent clarity on the obligations and risks of developers.

Not to forget the Electricity Act 2003 and subsequent follow-up policies that also did their bit in encouraging hydro development.

Major development of Hydro potential occurred in the Himalaya mountain ranges including north east of India. However the hydro power potential in central India forming part of Godavari, Mahanadi and Narmada river basins has not yet been developed on major scale due to potential opposition from the tribal population.

Pumped storage schemes are perfect centralized peaking power stations for the load management in the electricity grid. Pumped storage schemes would be in high demand for meeting peak load demand and storing the surplus electricity as India graduates from electricity deficit to electricity surplus. They also produce secondary /seasonal power at no additional cost when rivers are flooding with excess water. Storing electricity by other alternative systems such as batteries, compressed air storage systems, etc. is more costlier than electricity production by standby generator. India has already established nearly 6800 MW pumped storage capacity which is part of its installed hydro power plants.

Issues liable for hold back of hydro development:

- Yet the same old issues continue to constraint the sector:
- Hydro projects are capital intensive, and capital costs are ever rising, though long term generation cost is low.
- Gestation periods are high
- Rehabilitation of project-affected people especially in storage based schemes for large area inundation – a Major issue.

  [The lesson of Tehri and Sardar Sarovar cannot be applied elsewhere as each project is unique and has its own challenges that call for an innovative approach. As finger print of no two persons are identical, so is with any two hydro sites; the hydrology must differ.]
- Interstate issues (such as water sharing)
- Land Acquisition problems (especially over how forest land is to be evaluated).
- Also, Dearth of good contractors
- Demand of local goons for extortion
- Political turmoil

To note that all of the challenges are attributable to Social or Political or Economic issues.

There are further:

Capacity additions and generation have routinely fallen short of the targets set in successive government programmers, while the objective of bringing in private investors has likewise proved difficult to realize.

- ❖ High upfront costs,
- ❖ Absence of long-term debt in India's capital markets and
- ❖ Consequent difficulties with financing

have been a major impediment to realizing India's hydropower potential.

Perhaps the most mention worthy TECHNICAL ISSUE specific to hydropower, is notably two types.

GEOLOGICAL : the high levels of sediment in the rivers coming down from the Himalaya Mountains, which can reduce reservoir storage capacity causing probability of inundation under flood condition and, if not removed, cause heavy damage to turbine blades and other steel structures in a hydropower plant.

TRANSMISSION SYSTEM: Much of the potential is in remote areas, necessitating new long-distance transmission lines to bring power to consumers.

Water issues are very sensitive in India and lack of public acceptance of hydropower development has already been a major obstacle to projects moving ahead. The most difficult issue has been the resettlement of people affected by new projects, but public attitudes have also been adversely affected by the by floods in the Himalayan state of Uttarakhand in 2013, which prompted a major debate over whether intensive hydropower development in the region was to blame for the severity of the flooding. This episode underlined the importance not only of evaluating individual projects in depth, but also of taking a broader and holistic view on the development of river basins, assessing the linkages between projects and the cumulative social and environment impacts.

TOWARDS BALANCE, HOLLISTIC AND BROADER APPROACH:

COAL: Chief Economic Adviser (CEA) Arbind Subramanian recently argued that since renewable energy sources come with hidden costs, coal - which is cheaper should remain India's primary source of energy and we should not allow the narrative of 'carbon imperialism' to come in the way of realistic energy policy and planning. The current over capacity in coal generation calls for coal to be the mainstay of energy needs.

RENEWABLES: Ajay Mathur, Director TERI, says that there is a broad agreement as we move to the future that all new capacity addition should be based on renewable beyond a certain date. We expect that price of electricity from renewables plus storage cost will be same as the cost of electricity from coal, by somewhere around 2025. We expect this will become Rs 5 per unit. The issue is what happens between now and 2025. Though the cost of electricity from renewable is now around Rs 11 per unit, it has two components: Rs 3 for electricity production and Rs 8 for Storage capacity. If battery prices reduce to one-third in next 10 years, its cost will be less than Rs 3 per kWh as is expected for larger scale use of battery. This works out the price of electricity Rs 5 per kWh in 2025.

INCREASING FOCUS ON RUN-OF-RIVER PROJECTS (WITH OR WITHOUT PONDAGE: these avoid expansive reservoirs and can thereby ease the need for resettlement and so help to secure public acceptance.
But these projects have little or no water storage (rarely more than the equivalent of a few hours' worth of generation), limiting their ability to be dispatched on a flexible basis. Their power output is often subject to significant seasonal variation.

DAMS: We cannot do away with DAM project. But its development must be compatible to the concept of sustainable development.

CARBON CREDITS: Carbon Credit benefits should be automatically available for all hydro projects and they must not be required to go through a lengthy and complicated process to obtain them.

Whether Covid-19 is a real threat for Renewables:

While we had started our energy discourse focusing our home – our country, we perhaps conclude the choice of energy in the context as well as perspective of debate arising out of pandemic. Some very wrong but intuitively appealing ideas about energy keep recurring - that energy decarburization is an unreasonable goal at this time because it's too expensive. What is surprising is that we saw this argument published in the *Financial Times* recently. The author then explained that reducing carbon emissions in the time of COVID elevates energy prices, which would reduce demand for energy hindering economic recovery, because of a posited "close relationship" between domestic gross domestic product and energy usage. Hence, policies that reduce greenhouse gas emissions and raise energy prices "would reduce economic growth."

We don't have the space to debate all these points. Let us consider just a few borrowing the counterpoints put forward by Alan Mammoser. First, energy demand has a low, short term price elasticity, meaning that demand does not change much as a result of price changes. Perhaps down 2% on a 10% price hike. Second, the cost of energy equals about 6% of gross domestic product. So it would take a massive price increase to make a dent in the economy, although some consumers would suffer, admittedly.

Third, since the analysis seems to be aimed at renewables, keep in mind that most renewables feed into the electric network and consumers pay for electricity delivery not renewables. Recent contracts with the grid seem to show that renewables are increasingly competitive with other new power sources, and we have calculated elsewhere that putting no-carbon generation into the network, over time, makes little difference to the electric bill, and the electric bill equals 2% of GDP, so let's not get carried away about impact. Finally, the best and cheapest way to reduce greenhouse gas emissions is to use less energy, not to install renewables. And this is relevant to the argument that follows. As for the disturbance of the oil and coal markets by renewables, which seems to be the real beef, is this a new type of phenomenon? Looking at the last 200 years of energy usage we see an ongoing process of displacement.

Fig.4: Renewable sector remains resilient

Coal displaced wood and water power. Kerosene and manufactured gas displaced sperm whale oil. Petroleum displaced coal and horses. Natural gas displaced manufactured gas and coal. Now it appears renewables will displace fossil fuels. And in due course something else is likely to replace renewables. The long term problem for fossil fuel producers lies with consumers who not only like to do more with less but also to try new products. It is not all about price. We thought that the notion that the economy moves in lockstep with energy consumption (or vice versa, more accurately) had been discredited years ago. Energy usage may rise and fall in the short term due to the economic cycle, but over the long term there has been a gradual decoupling of energy usage from economic growth. On a rough basis, that society modifies its consumption of energy in the same way as other commodities. But unlike other commodities, say sugar and coffee which we directly consume, we only "consume" the direct benefits of electricity—heating, cooling, illumination, refrigeration etc. The trend we see is constant effort to achieve the desired benefit with less energy inputs. The COVID pandemic should not become an excuse to abandon climate change mitigation measures or to promote a new strategy of doing less with more.

Fossil fuels are fighting renewables for a slice of a shrinking pie —the energy required to produce a dollar of GDP. Consumers of energy treat it the same way they treat any commodity. They look for ways to make do with less. Copper miners, now, rejoice at how many pounds of copper go into electric vs conventional vehicles. They need not get complacent. History suggests vehicle manufacturers will look for a cheaper replacement as soon as they can.

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Fig.1: Covid & Environment

4 Feature articles

Article-4

Non-propositional logic- A logic of quantum physics

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Logic is a mathematical model for deductive thoughts. Although the logic is basic to all other studies, its fundamental character were still discouraged any deep logical investigations until 19th century. Then, under the impetus discovery of non-Euclidean geometry and desire to provide rigorous foundation for calculus and higher analysis, interest in logic revived. A logical system is comprised of declarative sentences (proposition) construction, called syntax and for attributing meaning to these sentences, termed as semantics. Traditionally, logic has been the science which investigates a family of notions- consistency, validity, entailment and ultimately pertain to (sets of) sentences of a language. Thus a set of sentences can be consistent, one sentence may be entailed by another and so on. The state of a system and observable quantities of classical physics may be studied in the light of propositional logic. The algebraic structure of such type of logic is represented by the Boolean property of lattice.

The quantum theory incorporates a computational method for assigning probabilities to events or propositions or values of physical magnitudes- the dynamical variables or observables of the theory formulated in terms of the geometry of Hilbert spaces. In fact, the quantum system is defined on closed linear subspace S(H) of Hilbert space H, where one can think of the physical properties in terms of self-adjoint operators, it is more natural to associate quantum state with projection operators. The concept of quantum logic was first introduced by Garrett Birkhoff and John Von Neumann in 1936. They observed that the set of projection operators on Hilbert space constitute a logic of experimental propositions. Later on, the work was successfully modified or redefined by Mackey (probabilistic analysis of quantum theory, 1957), Piron (Piron's axiomatization, a significant extension of Mackey's theory, 1977). But, the most significant development to quantum logic, most notably, the empirical framework introduced by Foulis and Randall in the 1980's. However, a remarkable observation has been observed by American Philosopher as well as Computer scientists Hilary Putnam in his 1969 paper "Is Logic Empirical?" In that paper, the claim made are these

1. Logic is an empirical science; some of the "necessary truths" of classical logic could turn out to be false for empirical reasons (pp. 216, 226).

2. Just as the general theory of relativity requires us to move to a non-Euclidean geometry, so our best interpretation of quantum mechanics requires the adoptation of non-classical logic (p. 234).

3. By adopting quantum logic we can retain a strong account of the properties of the system (p. 229).

The algebraic structure to quantum logic forms an orthomodular lattice but not distributive. And the algebraic structure of classical logic is Boolean lattice (having distributive property). Thus the distributivity makes the difference between classical and quantum logic (a non-propositional logic). However, one can also think an alternative way to characterize algebraically the structure of the set of subspaces of Hilbert space as partial Boolean algebra (PBA) (Kochen and Specker, 1965; Hughes, 1985).

In this article, first I shall discuss the logic of classical physics with its algebraic structure as Boolean lattice. Secondly, I will highlight the facts about quantum logic as a non-propositional logic by giving an example of non-distributive, orthomodular lattice viz., Greechie lattice G_{12} in a 3-dimensional Hilbert space H_3.

Logic of classical physics

In classical physics one can think of the state of the systems as a sequence of coordinates of position-momentum phase space that essentially determined the system properties at any instant. The other way is to consider the state as a binary function of the set of experimental questions that describes the disposition of the system to yield certain measurement outcomes. In general, the structure of any possible experimental question something like, "does any observable A having a value within Δ?" In other words, one has to test the physical properties as whether $\omega(A,\Delta)=1$ if $f_A(\omega)\epsilon\Delta?$, where $f_A: \Omega\rightarrow R$ is the dynamical variable expressed as a phase space function. For example one might ask, "is the kinetic energy of the particle larger than 1 J?". The question corresponds to an observable which yields 1 if the answer is "yes" and 0 if the answer is "no".

In order to understand this, let us consider a simple experiment consisting of a box with transparent lid contains a "2 rupees" and "5 rupees" coins to rattle inside it. We thus have experimental questions to each of the coins "heads up or tails up". We represent this on a two-dimensional classical phase space (see figure 1). Using standard coordinates, let

P: set of points such that $y\geq 0$, P^c: set of points such that $y<0$

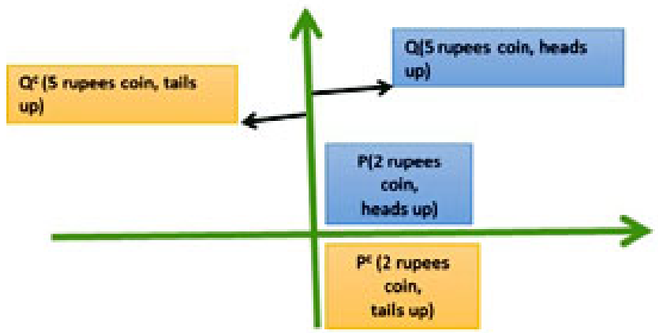

Figure-1

Q: set of points such that $x\geq 0$, Q^c: set of points such that $x<0$

Since the system is classical, these experimental questions are also the properties of the system. The state of the system is represented by the point ω in the phase space. In fact, ω specifies which face of each coin is the uppermost. For example, $\omega\epsilon P\cap Q^c$ means "2 rupees coin heads up" and "5 rupees coin tails up", which lies in the second quadrant. The phase space is classical not in the sense that it involves position or momentum coordinates but because experimental question are represented by the subsets of the phase space. The experimental question $P\cup Q$ receives "yes" when the system receives in configuration except 2 rupees coin tails up, 5 rupees coin tails up. Here, we have an example for the subset relation properties of the classical coins (see figure 2). The nodes refer to the possible subset inclusion of subsets in the lower nodes by sets in the higher nodes. Moreover, the graph of all possible subset relation involving the sets P, Q, Pc, Qc (see figure 3). The lines indicate subset inclusion of the lower nodes by the higher nodes to which it is connected.

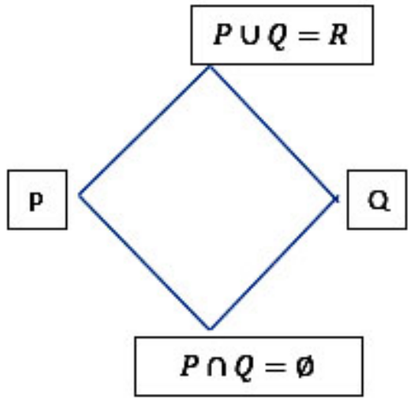

Figure-2

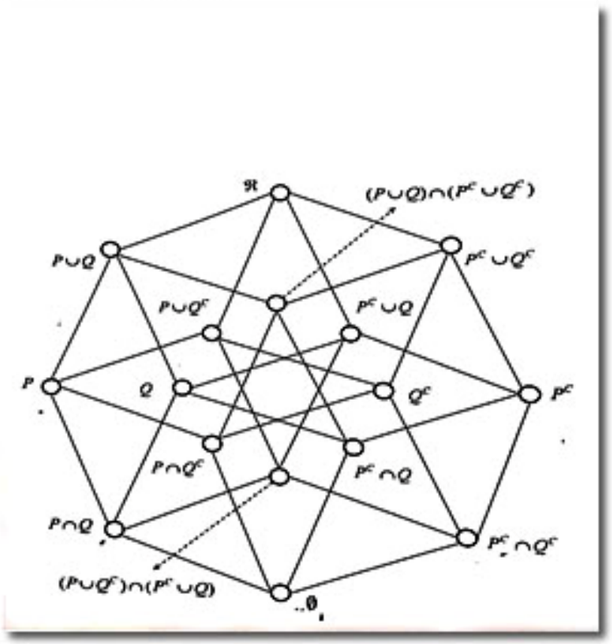

Figure-3

For each property there is a corresponding proposition that expresses the fact that the system has the property associated with the node in the graph. For example , the sentence ωϵP denotes the 2 rupees coin heads up where the synonyms associated with ωϵP is p; similarly the synonyms associated with ωϵQ is q; the synonyms associated with $\omega\epsilon P^c$ is ¬p (not p) and so on. There may be two binary connectives v (disjunction) and ∧ (conjunction) and the synonyms associated with $\omega\epsilon P \cup Q$, $\omega\epsilon P \cap Q$, $\omega\epsilon P \cap Q^c$ etc. respectively written as pvq, p∧q, p∧¬q. Similarly, a diagram like figure 3 can be drawn for those propositions. And, the lines in the diagram represent the relation entailment between sentences. The abstract characterization of this structure is Boolean algebra. This is significant in the context of classical physics because it means that it is more appropriate to think that because the logical propositions about classical systems is Boolean, the propositions can represented as the subsets of phase space. Thus, the classical system leads to Boolean property lattice.

Quantum logic

The set of experimental question in quantum physics is a set of quantum events or just event. Since each quantum events is represented by a closed linear subspace S(H) of a Hilbert space H, quantum logic involves giving an algebraic characterization of the set S(H) of these subspaces. S(H) forms a lattice L(H), it is a Partially ordered set by inclusion and for any pair of subspaces L and M, there is greatest and least subspaces which respectively have the common and least subspace which contain them both. We may define the meet and join on L(H) as follows:

L∧M=$LL \cap MM$, L∨M= ∩{N : N ∈ S(H), L ⊆ N, M ⊆ N} The union of two rays contains just the vectors in two rays; since it does not contain all linear superposition of these vectors, it is not a subspace. The span of two rays is the plane containing them both and it is this which, in lattice theoretic terms, is the join of two rays. H is the maximum element and {0} is the minimum element of L(H). The closure of the set of vectors orthogonal to L is L⊥, which is orthocomplement to L.

It is defined as L⊥ = {| x >:< x | y >= 0,| y ∈ L}. Also, it can be show that
(L⊥)⊥ = L, L ∨ L⊥ = 1, L ∧ L⊥ = 0
Now, we can compare the class of lattices L(H)

1. Lattices with maximum and minimum elements
2. Complemented lattice
3. Orthocomplemented lattice
4. Orthocomplete lattice
5. Orthomodular lattice.

It is to be noted that (5)⇒ (4) ⇒ (3) ⇒ (2) ⇒ (1) and there are plenty of examples to show that the converse may not be true. The above set of vectors of H forms an orthocomplemented lattice which is not distributive.

Greechie lattice G12

Greechie lattice G12Greechie Lattice G12 (see figure 4) consists of subspaces of two triples a={U,V,W} and b={X,Y,W}. The two subspaces corresponding to each triple ( ) plus the empty set and 3-dimensional Hilbert space H3 of Greechie lattice G12 forms a distributive sublattice of eight elements

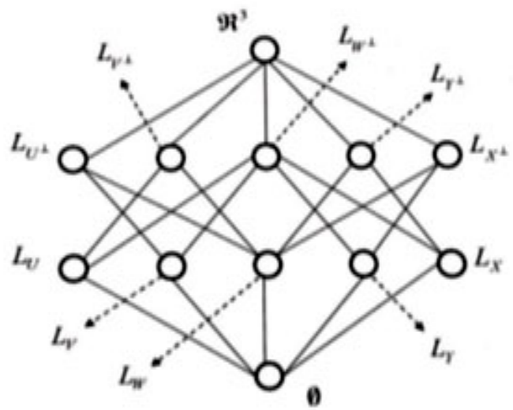

Figure-4

Let, Lx: rays spanned by x, Lx: rays spanned by x, Lxy: rays spanned by x and y
The four vectors x, y , u, v lies in one plane; thus Lxy= Luv= Lux= Lyv and so on.
Consider the subspaces Lx∧(Luv Lv). Since, Luv Lv= Luv= Lxy, we have Lx∧(Luv Lv)=Lx∧Lxy= Lx. On the other hand, Since, Lx∧Lu={0} and Lx∧Lv={0}, we have (Lx∧Lu)v (Lx∧Lv)={0}v{0}={0}
Thus, Lx∧(Luv Lv)≠(Lx∧Lu)v (Lx∧Lv).
But it is an orthomodular lattice since orthomodular identity holds.
Thus, from G12, it can be observe that,

- G12 contains two distributive sublattices of eight elements, one is generated by Lx, Ly and Lw and another by Lu, Lv and Lw.
- These two sub lattices are so to "pasted together" at the points {0}, R3, Lw and L⊥
- Each of them is complemented distributive lattice, in other words a Boolean algebra.

Closure

The present form of quantum logic which is non-propositional in nature is basically two-valued logic. In order to handle the Heisenberg uncertainty, we discard the distributive law of propositional logic. But the present form of quantum logic does not handle uncertainty in general. Thus, in order to modify the quantum logic we can develop a bilattice structure on Hilbert space where the x-axis is truth (multivalued) and the y-axis is vagueness in information i.e. knowledge.

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Fig.1: Covid & Environment

4 Feature articles

Article-5

The curious case of COVID-19 in India

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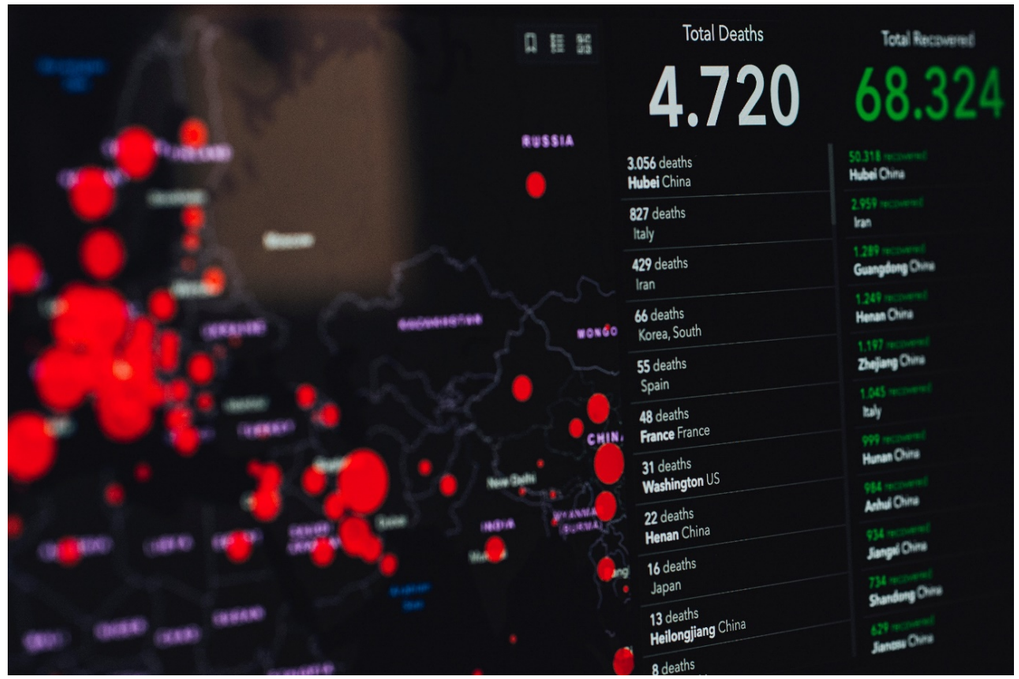

Since its discovery in Late December of 2019, COVID-19 has spread like a wildfire through the world. As of April 15, the pandemic has infected just 2 million people and has killed more than 100 thousand worldwide, showing no signs of stopping. And with the rapid shifting of the epicentre of the infection from China to Europe and now to the United States of America, much concerns and speculations have been raised as to the next hot spot of the infection.

From the beginning of the pandemic, experts from around the world have been speculating about the fate of India. A lot of scepticism has been levelled at the country's ability to control the spread of the pandemic, with some predicting a case load of around 300–500 million with a death toll of around 10 million in a population of around 1.4 billion people. Even projections that predicted lower case loads were equally grim, with predictions of deaths being counted in millions.

However, the reality has been somewhat different. As of April 15, 2020; three months into the pandemic, India has recorded 11,838 confirmed cases, of which 1,393 have recovered and 403 people have died. Although these are high numbers, they are far below the numbers that countries like United States, China, Italy, or Spain have recorded. A major criticism of these numbers is that India is testing very little. And unfortunately, that is true. India has one of the world's lowest testing rates, having tested around 250,000 people in total, or 177 tests per million people. By contrast, Italy has a testing rate of 16,708 tests per million people, South Korea 10,038 tests/million and USA has 8,609 tests per million. While countries like USA or Italy have been testing anyone and everyone who even sneezes wrong, till date India has been following a strict testing criterion, only conducting tests on people who have a history of foreign travel, contacts of known COVID-19 cases or patients having severe acute respiratory illness (SARI).

Experts have speculated that this low testing rate is the major cause behind such low case numbers, and the real COVID-19 burden of India is many magnitudes greater than what is seen. However, if such was really the case, then over the past few weeks India would've seen an explosive rise of people getting admitted in hospitals with SARI, as people who are infected but not tested would've spread the disease to other vulnerable people around them, leading to a sudden and unaccounted for rise in SARI cases that would turn out to be positive for SARS-CoV-2 (since **all** SARI patients are being tested for COVID-19). But as of now, that has not happened. So, what is India doing right? Or are the speculations actually true, and we are closer to the predicted doomsday scenario than we think? And where is the country headed?

What are the factors working for India?

In its fight against the SARS-CoV-2, India has several advantages. One of the major ones is its demography. India has one of the world's youngest populations, with a median age of 29 years, and less than 5% of the population over 65 years. Compared to this, China has a median age of 38.4 years and over 10% of its population is aged 65 years and above. Italy and Spain are two of the hardest-hit, and oldest countries in the world, with median ages of 45.8 years and 43.1 years respectively. Over 20% of Italy's population are above 65 years old, for Spain that is more than 16%. Severe forms of COVID-19 affect mostly people of older age and people with other morbidities (almost 85% of all deaths are in people more than 65 years or older). Coupled with a comparatively lower life expectancy (70 years), India has a far smaller population that is at risk of developing severe disease and dying from it. It has been seen that young people are not only much less likely to contract the disease (especially SARI) but also recover quickly and do not spread as much. Therefore, a larger young population acts as a buffer that prevents the disease spreading into the susceptible population. And not only India, the same pattern is observed in countries like Brazil, South Korea, or African countries; whose population are much younger than those of Europe.

But 5% of 1.4 billion people is still 70 million people (more than the entire population of Italy), and India has one of the world's highest rates of diabetes and hypertension. Even if we consider the demographic buffer, India should be seeing much higher numbers of SARIs and deaths, which is not the case. This is because although it is a respiratory infection, COVID-19 has been seen to occur in geographical clusters. New York in USA, Lombardy in Italy, Wuhan in China, Maharashtra in India have all been geographical clusters of the disease. It is when infected people start travelling to other parts of the country from those clusters does the infection spread. Therefore, a travel restriction put in place can go a long way to stop the spread of the disease among the general population. India was one of the first countries to ban all international travel to and from the country. It was also one of the very few countries to have imposed a strict lockdown measure, stopping almost all of its domestic land and air transport. These measures have had two effects. Firstly, these measures have drastically reduced the initial pool of infections in the country. Secondly, the movement of infected people from the clusters have been halted, thus reducing the spread of the disease among the population.

India was also quick to identify super spreading incidents (the preacher in Punjab, people attending a religious congregation in Delhi) and rapidly traced, tested, tracked, and isolated cases and quarantined their contacts. One of the super spreading incidents (the congregation in Delhi) is responsible for more than one-third of all cases of the country and was the cause of the sudden spike in cases and deaths, raising alarms. However, prompt actions taken to contain those cases and their contacts have led to the prevention of the spread of the diseases among the populace.

So that means Indians are safe?

Not really. Since this is a pandemic caused by a respiratory virus that humanity had no prior encounter with, no one knows how it will progress.

spreading the virus within the population. Factors like very high population. And in case of India, for each favourable factor there are a number of other factors that are conducive towards spreading the virus within the population. Factors like very high population density in the cities, overcrowding, poor sanitation, and hygiene practices are all favourable towards the propagation of the disease, as the virus is transmitted primarily through aerosols and close contact with an infected person.

India is also uniquely vulnerable to super spreading incidents. Although the government has banned any and all gatherings of more than 25 people, it is very hard to enforce social distancing norms in one of the world's most densely populated countries. And in places with high rates of overcrowding like the urban slums, just one infected person can easily result in a super spreading incident by virtue of him/her coming in contact with potentially thousands of other people.
Then there are the unintended consequences of the pandemic. In a country where almost one third of the population lives under the poverty line, extended periods of lockdown will lead to severe economic consequences. Daily wage earners will be hit especially hard due to the job losses in this period, which will not only lead to a disruption of the economic supply chain but also might add to the crisis by deepening the problems of malnutrition, undernutrition, and predisposition of a large part of the population to developing a variety of other diseases. If not managed properly, the pandemic, and the measures of controlling it might unintentionally give rise to the same situation that was faced by the country during the 1918 Spanish Flu pandemic, where more people died of malnutrition than due to the disease itself.

What is the way forward?

With only around 3% of the country's GDP being spent on healthcare, India is also ill-prepared to tackle severe cases should the situation go out of hand. Almost all of the Indian states have been reporting severe shortages of ventilators, personal protective equipment for healthcare personnel, and essential medicines. Therefore, investing heavily in preventive measures is the best way to move forward.

The 21-day long complete lockdown is a great first step, as it has given the government breathing time to properly prepare by delaying the eventual peak of the infection. However, lockdown in and of itself is not a solution. The country must now enforce strict social distancing norms and personal hygiene practices. Investing heavily in the public health system by having public health experts closely monitor the pandemic, ramping up the daily testing rates, mobilising personnel to rapidly and aggressively trace, track, test and treat cases and their potential contacts are of immense importance. These measures, coupled with setting up of quarantine zones, launching campaigns to promote handwashing, social distancing, and wearing masks in public should be prioritised. Because no matter how many ventilators are bought/made, the system will be overwhelmed if the pandemic gets a foothold in the country. Proper protection must also be ensured for the people working in the essential services, not only to save their lives but also to prevent them from being infected and spreading the disease to other susceptible people whom they are serving.

And last but not the least, the people of India must start changing their lifestyle for the better. This is the best time to stop spitting on the roads, practice proper handwashing, using tissues and handkerchiefs while coughing and sneezing, and quitting habits like smoking, which puts us at a greater risk of contracting the disease and developing severe forms of it.

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