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Tête-à-tête with

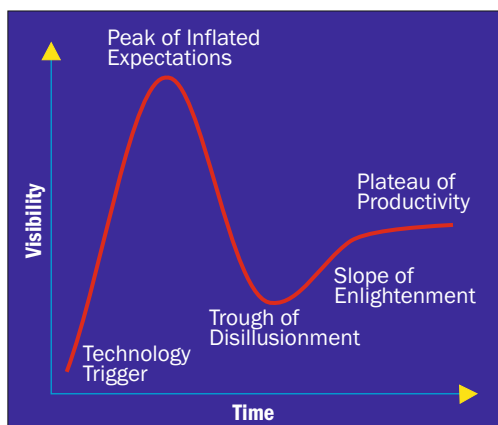
Dr. Shashank Chaturvedi

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M. Padmanabhan: It is recalled that in 1928 the famous French economist J.B. Say remarked “Nevertheless no machine will ever be able to perform what even the worst horses can - the service of carrying people and goods through the bustle and throng of a great city”. Today we have driverless cars and hence it is very difficult to predict future impact that technology will have on the society. What is your comment on this? Is it just a bubble or the next big thing?

Dr. S. Chaturvedi: AI is already in widespread use for a variety of applications. The well-known curve given below shows the expectation from any new technology as a function of time. Every innovation sees a rapidly-increasing expectation level, reaches a peak of inflated expectations, then crashes into a trough of disillusionment before reaching a plateau of “true” productivity. The AI revolution is likely to follow the same trend, and we may currently be near the peak. But the real-life contributions already made by AI clearly show that it is certainly not a bubble.



M. Padmanabhan: The impact of the industrial revolutions has, undoubtedly, been substantial on all aspects of our society, quality of life and employment. Then came the digital revolution; use of computers and communication changed the way that we worked, interacted. It shaped the industries in transportation, automobiles, energy, finance and production of other consumer goods. Will the forthcoming AI revolution produce similar, far-reaching effects?

Dr. S. Chaturvedi: The AI revolution has already produced major effects across a range of activities. Customer care services have been taken over by chat bots and the job of salesmen is being done by automated recommendation systems. In healthcare, it is transforming cancer diagnosis & treatment by improving data analysis, interpretation & planning. It is already part of technologies for analyzing crop yields & improving irrigation, and is now being adopted in precision agriculture (PA). Propagation of PA can be a game-changer for India, due to small-holdings of individual farmers so that major industrial tools & techniques cannot be applied. New drug discovery may be faster and cost-effective. Automatic text-to-text translation between arbitrary pairs of languages has transformed communication. Now, we are not bounded by the language differences as AI based real time translation tools are available. AI also finds application in fraud detection in financial transactions, etc. If and when driverless cars become reliable, they may help improve traffic flow in cities and reduce loss of life from traffic accidents. So it is very ...



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likely that the growth seen in the IT industry over the last 20 years (from 2000 – 2020) could be replicated in AI over the next 20 years.

M. Padmanabhan: Content suggestions, response suggestions, filter suggestions for images are few common AI assists that has started influencing social media. Do you see human interpersonal communication and relations being influenced by this technology in near future?

Dr. S. Chaturvedi: Content suggestions and recommendation systems certainly affect the thinking of individuals and their relationships. There is a major impact in the area of news & opinion dissemination. When people relied on newspapers & magazines, they were compulsorily exposed to news & opinions from a variety of areas/sources, and had to make a conscious decision to ignore certain kinds of news & opinions. However, AI-driven choice of news items means that people learn more-and-more about less-and-less; this could make them less-informed about other important areas. Also, they keep seeing articles that more-or-less match their existing opinions on certain subjects – a classic positive feedback system. This could lead to polarization of opinion, without people even being aware that their opinions are based on limited knowledge. With adolescents increasingly getting their news and opinions from Social Media driven by AI, this polarization will have a major effect in the coming years.

M. Padmanabhan: Nuclear energy remained a sector where knowledge and innovation remains a key in producing electrical power in a safe and

secure manner. How do you think AI led innovation is going to help the nuclear industry?

Dr. S. Chaturvedi: AI is going to help the nuclear industry in terms of both science & technology. In nuclear science, AI techniques are helping in experiments, making new discoveries, developing new theories by helping researchers quickly analyze large amounts of data, finding new patterns and creating sophisticated data models. In nuclear power, it can help in improving reactor designs & optimizing processes. Through improved automation, it can improve operation efficiency and help increase reliability of components/sub-systems. Utilizing its power of analyzing complex patterns, it can assist in detecting potential anomalies and predict component failures well before they are imminent. A detailed discussion of AI applications in these areas is available from:

<https://www.iaea.org/newscenter/news/seven-ways-ai-will-change-nuclear-science-and-technology>

M. Padmanabhan: You are shaping Indian participation in the Nuclear Fusion research in India as well as in the international collaboration at ITER. Are there applications of AI in fusion research?

Dr. S. Chaturvedi: AI is already being applied in several areas of fusion research. These applications of AI are included in a new five-year IAEA coordinated research project aimed at accelerating fusion research and development. One of the important applications is the real-time prediction of



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plasma disruptions in tokamaks, which is critical for timely deployment of disruption-mitigation techniques. Another area is the optimization of performance of emerging fusion concepts, based on large experimental datasets, without detailed modelling of the underlying physical phenomena. A third is the prediction of the time to failure of critical machine components. A fourth is the area of Remote Handling in fusion machines – for example, AI can be used for automatically detecting damaged in-vessel components like plasma-facing graphite tiles, so that they can be replaced by remote handling tools.

M. Padmanabhan: AI is coming in a big way in health care, medical imaging and supporting geriatric care. However, it is seen that a majority of such devices are not produced in the country. What is your comment on that?

Dr. S. Chaturvedi: Health care & medical imaging make use of equipment/machines that are normally imported from abroad. Such imported hardware, with integrated software, is generally costly, and is thus accessible only in cities and larger towns. The limited availability of healthcare specialists and sophisticated equipment in rural and semi-urban areas is thus a major issue in India. A multi-pronged effort may provide the solution. The first is to indigenously develop and deploy low-cost diagnostic equipment in all towns/villages, using mobile teams. The second is to digitize, at a National level, physical diagnostic reports like X-ray films and their diagnoses by specialists, and to train indigenously-developed AI-software based on this database. The third is to use this

AI software through a National portal where X-ray images etc can be uploaded for an automated, high-speed diagnosis. An effort of this type is already underway in India based on chest X-ray images-IPR has developed a deep learning software 'DeepCXR' as a part of an ICMR led AI-TB program for training AI models for detection of chest ailments in Chest X-Ray images. We have also developed an automated system 'AIBacilli' for detection of TB using microscope images of the bacilli. The need for a coordinated National effort cannot be over-emphasised--in a country like India, there are large geographical variations, making a national database essential.

M. Padmanabhan: How do you see the impact of AI on national security; cyber as well as physical?

Dr. S. Chaturvedi: It is said that "Data is new Oil", and this data can be used in both ways. AI can help in analyzing abnormal behavior patterns among large datasets, highlighting anomalous behaviour for appropriate action. AI has major applications for Security agencies in high-speed automated analysis of speech, image, signal and video data. On the other hand, AI is now being perceived as major threat in cyber security due to its ability to operate 24/7 and because it is continuously adapting. AI imposes a huge challenge to cyber security as it has become difficult to distinguish between real data and fake data. Also, with advancement in digital technology, most of the data such as personal, private, confidential & financial are available online and become prone to cyber-attacks. In the ...



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defense sector, many countries are investing big time in AI-enabled systems such as autonomous drones, robot soldiers, training platforms etc.

M. Padmanabhan: Use of AI and ethics remain often contradictory. Use of AI in various applications raises questions of issues with privacy. Possibly legal issues involving use of AI is also not firmed up. How should we address this?

Dr. S. Chaturvedi: In the past, if you needed to spy on someone, it necessitated a physical effort to track, trace and follow, which required deployment of a considerable number of people. But today, you can gather information about someone just from his/her digital footprints. Usage of AI adds another layer, allowing you to know the likes/dislikes and perform behavioral analysis of any individual. There is little point in preaching to people about the ethical usage of AI, as anyone with access to data can do whatever he/she wants. A Legal framework is necessary but not sufficient. It is also necessary to restrict access to data. The data should only be shared with trusted individuals/organizations. AI ethics should be part of education, and schools should continuously alert students to the potential misuse of their data. In 2018, Niti Aayog released the National Strategy for Artificial Intelligence (NSAI) discussion paper which, while highlighting the potential of Artificial Intelligence (AI) for accelerating growth, also emphasized the social potential of large scale adoption of AI with a focus on themes of

inclusivity, adopting the theme of 'AI for All' As AI is still developing rapidly, the risks associated with it are also increasing.

M. Padmanabhan: What is your advice to the young budding engineers, scientists and social scientists on having a career interwoven with his area of work and application of AI?

Dr. S. Chaturvedi: Young budding engineers/scientists must continuously update themselves about the applications of AI in their own areas of expertise. There is a large and growing body of literature in the open domain. At the same time, they should realise that the accuracy of AI is limited by the availability of large datasets which are not always available; also, available datasets may be limited in their scope, and AI models trained on this data may not be generally applicable. Hence it may turn out that a combination of physically-based models with AI would give the best results.

M. Padmanabhan: Role of AI in Big Data Analytics and especially in LIGO?

Dr. S. Chaturvedi: Given the large amounts of data generated by gravitational wave observatories, AI has an important role to play in gravitational wave analysis. The AI ensemble used is reported to be used for advanced LIGO data within just seven minutes and revealed no misclassifications. More details are available from: <https://news.uchicago.edu/story/scientists-use-artificial-intelligence-detect-gravitational-waves>.