

Chapter 55

Big Spectrum Data and Deep Learning Techniques for Cognitive Wireless Networks

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ABSTRACT

The present world is data driven. From social sciences to frontiers of research in science and engineering, one common factor is the continuous data generation. It has started to affect our daily lives. Big data concepts are found to have significant impact in modern wireless communication systems. The analytical tools of big data have been identified as full scale autonomous mode of operation which necessitates a strong role to be played by learning based systems. The chapter has focused on the synergy of big data and deep learning for generating better efficiency in evolving communication frameworks. The chapter has also included discussion on machine learning and cognitive technologies w.r.t. big data and mobile communication. Cyber Physical Systems being indispensable elements of M2M communication, Wireless Sensor Networks and its role in CPS, cognitive radio networking and spectrum sensing have also been discussed. It is expected that spectrum sensing, big data and deep learning will play vital roles in enhancing the capabilities of wireless communication systems.

INTRODUCTION

The present world is data driven. From social sciences and humanities to frontiers of research in science and engineering, one common factor that is emerging is the continuous data generation (Cui, Yu and Yan, 2016). It has started to affect our daily lives. The scanned copies of old books and digital versions of recent editions in libraries, fluctuations in stock markets, daily transaction of banks, high definition movies and audio content, continuous multimedia interaction over internet, super resolution television broadcasts, diagnostic records etc are some of the major factors that are generating a significant portion of data. More importantly, some other generators are related to internet based social media services especially Facebook, Tweeter etc. which contribute (30 billion pieces of content per day for Facebook, over 90 million tweets in a day by Tweeter etc.) huge volumes of data daily. A very busy stock exchange like the one in New York generates 1 Terabytes of data daily while a single flight of the Airbus A 380 generates 640 Terabytes of data (Bi, Zhang, Ding & Cui, 2015). This voluminous expansion of data has been a decisive factor which has contributed towards the emergence of new areas of research that have significant linkages with data. In a worldwide scale, number of internet users is increasing day by day. More than 4 million users use internet daily. It is assumed that by 2020, 50 billion numbers of devices will be attached with internet and it will require separate slots for use of spectrum both in wired and wireless modes and need high end support for storage of information (Kadir, Shamsuddin, Rahman & Ismail, 2015). In Nature and another leading science and technology magazines, several special issues have been published and indicators identified to enlarge the scope of big data related research in technological domains. The most significant driving factor behind the importance being attached to big data is the fact that it is unlike the presently known forms of data blocks and along with present day technology, creates an opportunity to formulate innovative means of data driven applications. Actually big data presents a very large system which is complicated to handle using traditional data base management systems. According to popular definitions, big data has been popularized with 'five Vs'. These are volume, value, variety, velocity and veracity. Big data is a continuously expanding data base that consists of large number of data from our surroundings collected from several sources like sensors, media, videos etc. In modern wireless communication system, big data concepts are likely to have significant impact and are becoming an interesting domain of research. Communication especially wireless and mobile, are expected to be transformed due to the use of big data concepts. It is expected to be an aid to the overall quality of service (QoS) in terms of better spectrum management, call handovers, link adaptability and reliability, channel assignments, geo-location and traffic management, routing, etc. to name a few. Much of the deployment and design of emerging wireless and mobile networks are expected to go through a paradigm shift due to the use of big data concepts. The present era is also known for the evolution of smart technologies and one such development which has brought cognition in the lives of the people worldwide is Cyber Physical Systems. Around 2006, it was National Science Foundation (NSF) that coined this term. Since then, wide and deep research activities on CPS have been carried out by industries and academicians. The developments in this domain have been fuelled by the advances taken place in the genres of embedded systems, communications, sensor networks, computing and control engineering. CPS have emerged as a vital technology that can enhance human-to-human, human-to-object and object-to-object interactions. Big data,, Cyber Physical System (CPS) and deep learning are expected to contribute significantly towards the evolution of a new generation of communication technologies which will nullify most of the constrain currently encountered and improve QoS, bandwidth utilization and lower power consumption to levels previously unheard of.

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