Call for Chapter: Big Data Analytics in Cyber-Physical Systems

Machine Learning for the Internet of Things

Edited by:

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Cyber-physical systems (CPS) and the Internet of Things (IoT) are developing rapidly and this technology is now transforming our economy and society. However, the pure technological aspects of IoT and CPS, such as networks, embedded systems and cloud technology, will not provide the biggest growth. A disruptive transformation of the economy and society is expected due to the data collected by these systems. Also, the data itself is not the key component for new business models. To create value out of the data, it must be transformed to information. Therefore, expertise in data analytics and machine learning is the key component of future smart systems. Hence, significant improvement of the current distributed signal processing methods, machine learning, data science and optimization tools in combination with CPS applications are required.

For the pervasive establishment of smart cyber-physical systems in our economy, new algorithms in combination with new hardware components has to be developed. Despite the technological advances, new concepts of education especially in the field of machine learning and data science are required as well. To integrate this technology in our industry, knowledge of machine learning and data science needs to be combined with expertise in networks, control technology, sensor technology and embedded systems.

The digitalization of our schools and education is another challenge. The book addresses technological advances in machine learning, data science, and optimization in combinations with applications in IoT and CPS, e.g., mobility, industry, and environmental systems. This includes fundamentals of (sensor) signal processing in combination with data analytics and machine learning (e.g., smart sensors and IoT gateways), optimization and decision making in smart systems (e.g., intelligent mobility) and the implementation of new machine learning algorithms in embedded systems.

Additionally, this book addresses also new concepts of education to transfer this technology in our society. Especially small and midsize companies need qualified employees to create new business models with Internet of Things applications. People with knowledge of data analytics and machine learning together with practical experience in IoT and CPS are rare. Those having this knowledge might prefer to apply at big players and not consider classical companies in mechanical engineering or other domains with interfaces to novel IoT technology.

Desired Table of Contents and Chapter Summaries

List the chapter titles and provide up to a paragraph description on what each chapter covers. We expect 15 chapters for the book. We have identified 6 aspects on new technology: Mathematical foundation of machine learning and data analytics in CPS, new efficient algorithms, system design, system verification, hardware aspects, and security. Furthermore, we have 6 application domains for big data analytics in CPS in smart cities: Smart sensors, logistics and transportation, autonomous driving, Internet of Things for environmental systems, autonomous systems, renewable energy systems. Finally, we will have 3 aspects on education such as: new platforms for IoT in schools (microBit, etc.), new courses and concepts for universities and adult education on IoT and data science.

Part 1: New Technology and Fundamentals

1. Fundamentals/Tutorial on **Data Analytics and Statistics** for Cyber-Physical Systems (state of the art): This chapter should cover fundamentals of statistics and analytics for CPS and the Internet of Things. The chapter should have a tutorial character and present a broad overview of all available tools and methods to the readers.
2. Fundamentals/Tutorial on **Machine Learning** for Cyber-Physical Systems (state of the art): This chapter extends the previous chapter with more advanced concepts of analytics based on machine learning. The chapter should cover topics such as pattern recognition, support vector machines, optimization, and neural networks.
3. Fundamentals/Tutorial on **Concepts for the Internet of Things and CPS** (state of the art): This chapter presents fundamentals of hardware, software and network aspects of theIoT and CPS. This includes hardware platforms, software concepts and tools, cloud (thingspeak) techniques and communication technology such as wireless communication for IoT (e.g., narrowband IoT) and communication protocols (e.g., MQTT).
4. **Sensor-Platforms** for Smart Cities (partly new contribution): This chapter should present an example of a new sensor platform for smart cities. A possible contribution would be a sensor platform in combination with smart lighting or traffic sensor for the estimation of traffic statistics. This chapter should describe an entire system from the software/hardware to the network infrastructure and sensors.
5. **High-end Hardware** Aspects on **Autonomous Driving Platforms** (partly new contribution): This chapter will present new concepts for high-end hardware architectures for autonomous driving. Here, e.g., specialized platforms for machine learning algorithms are possible contributions. A very challenging research question is the design of specialized platforms for real-time capable learning algorithms.
6. **Low-cost hardware Platforms for the IoT in Smart Cities** (partly new contribution): This chapter includes a contribution for low cost hardware platforms for distributed sensor networks for IoT. This also covers an overview (or examples) of maker based innovations and an overview of ideas of the Arduino community.

Part 2: Application Domains and Societal Aspects (partly new Contribution)

7. **Environmental Information Systems** and Data Analytics (partly new contribution): Within this chapter, a technology for the estimation and evaluation of environmental

data (e.g., also data from renewable energy sources) should be presented. This includes the necessary technology as well as the data analytics. Here a contribution with new data is desired.

8. Future **Transportation Concepts** with Autonomous Driving (partly new contribution): This chapter presents possible innovation in case of completely autonomous vehicles. This includes transportation as well as logistics. An overview of the necessary optimization and analytics tools is also given.
9. Recent Topics on **Localization and Logistics** (partly new contribution): This chapter presents new applications of machine learning and data analytics for logistics or localization use case. This chapter can cover indoor as well as concepts for outdoor localization or logistics.
10. Reduction of **Carbon Footprint with e-Mobility and Autonomous Driving** (new contribution): Here a study of carbon footprint of future e-Mobility and autonomous driving is presented. The chapter includes new data and presents a detailed study on possible technological innovations.
11. **Smart Hospitals**: IoT and Machine Learning in future Intensive care (partly new contribution): New concepts of risk prediction in intensive care based on machine learning and data analytics.
12. **Societal** Aspects of Future **Smart Mobility** (discussion): This chapter covers the societal aspects of this technological revolution. IoT and CPS allow the collection of an enormous amount of data. This includes also data of individuals. The privacy aspect could be in future a serious thread for our democracy.
13. **Data-Analytics and Privacy: Techniques and Algorithms for Privacy Preserving CPS and IoT** (partly new contribution): This chapter investigates new studies on the privacy of new mobility services in smart cities.

Part 3: Future Demands on Education for IoT and Data Analytics

14. Aspects on Education for **Pupils** in IoT (discussion): This chapter presents an example how to educate pupils in IoT. Programming tools and hardware platforms which can be easily used by pupils and integrated in possible classroom courses will also be presented. This chapter will also discuss the importance of well-educated pupils for our future IoT-economy.
15. New Training Platforms for **Students** in IoT and Data Analytics (discussion): This chapter will be an extension of the previous chapter and present new concepts of practically machine learning courses for universities. The students should not only learn the theoretical aspects of IoT and machine learning. An important aspect is the understanding of a complete system including sensors, communication technology and data analytics and machine learing.
16. **Adult Education** for IoT and Data Science (discussion): This chapter will dicuss the demands on future adult education which is necessary to be up-to-date with fast evolving technology such as IoT and machine learning.

Online Material and training data is also a part of this Book