**PhD Lecture**

In partial fulfillment of the terms for obtaining the PhD degree, Bijay Neupane will give a lecture on the following subject:

**Predictive Data Analytics for Energy Demand Flexibility**

on Friday 3rd of November 2017, 13:00, in room 0.2.12 at Selma Lagerlöfs Vej 300

**Abstract:**

The depleting fossil fuel and environmental concerns have created a revolutionary movement towards the installation and utilization of Renewable Energy Sources (RES) such as wind and solar energy. The RES entails challenges, both in regards to the physical integration into a grid system and regarding management of the expected demand. The flexibility in energy demand can facilitate the alignment of the supply and demand to achieve a dynamic Demand Response (DR). The flexibility is often not explicitly available or provided by a user and has to be analyzed and extracted automatically from historical consumption data. The predictive analytics of consumption data can reveal interesting patterns and periodicities that facilitate the effective extraction and representation of flexibility. The device-level analysis captures the atomic flexibilities in energy demand and provides the largest possible solution space to generate demand/supply schedules.

The presence of stochasticity and noise in the device-level consumption data and the unavailability of contextual information makes the analytics task challenging. Hence, it is essential to design predictive analytical techniques that work at an atomic data granularity and perform various analyses on the effectiveness of the proposed techniques. The Ph.D. study is sponsored by the TotalFlex Project (http://www.totalflex.dk/) and is part of the IT4BI-DC program with Aalborg University and TU Dresden as Home and Host University, respectively. The main objective of the TotalFlex project is to develop a cost-effective, market-based system that utilizes total flexibility in energy demand, and provide financial and environmental benefits to all involved parties. The flexibilities from various devices are modeled using a unified format called a flex-offer, which facilitates, e.g., aggregation and trading in the energy market. In this regards, this Ph.D. study focuses on the predictive analytics of the historical device operation behavior of consumers for an efficient and effective extraction of flexibilities in their energy demands. First, the thesis performs a comprehensive survey of state-of-the-art work in the literature. Second, the thesis contributes to a comprehensive analysis of energy consumption behavior at the device-level. Third, the thesis presents various prediction models that are specifically tuned for device-level energy demand prediction. Fourth, the thesis proposes a generalized process for automated generation and evaluation of flex-offers from the three types of household devices, namely Wet-devices, Electric Vehicles (EV), and Heat Pumps. Fifth, the thesis presents user-comfort oriented prescriptive techniques to prescribe flex-offers schedules. Sixth, the thesis contributes to the comprehensive analysis of the financial viability of device-level flexibility for dynamic balancing of demand and supply. The thesis quantifies the financial benefits of flexibility and investigates the device type specific market that maximizes the potential of flexibility, both regarding DR and financial incentives. Seven, the thesis presents a benchmark platform for device-level demand prediction.

Members of the assessment committee are Associate Professor Bin Yang, Aalborg University, Mathieu Sinn PhD, Research Manager, IBM Research, Ireland, and Professor Toon Calders, University of Antwerp, Antwerpen, Belgium. Professor. Torben Bach Pedersen (Aalborg University) and Prof. DR-ING. Wolfgang Lehner (TU Dresden, Dresden, Germany) are Bijay Neupane’s supervisors. The moderator is Associate Professor Simonas Saltenis.

All interested parties are welcome. After the defense, the department will be hosting a small reception in cluster 3.