AI/IoT Workshop on Energy Data

@OIST Conference Center, Meeting Room 1

Friday, Jan 11th, 2019

13.30

Toru Yano, Corporate Research & Development Center, Toshiba
矢野亨、株式会社　東芝、研究開発センター、システム技術ラボラトリー

Application of survival analysis to Heating, Ventilation and Air Conditioning (HVAC) control

Survival analysis, which deals with durations until events occur, has been used for medical sciences and maintenance engineering. We here talk introduction of survival analysis to HVAC control methods. Based on the assumption that durations of set-point temperature or interruption time may tend to be long if occupants think of the condition as acceptable, we can obtain durations of set-point or interruption and change of set-point or restart of a HVAC appliance, respectively. By using these data, we have proposed the HVAC control methods that use acceptable set-point temperature estimation and acceptable interruption time in space heating and cooling, respectively. We performed a field test for space heating control using acceptable set-point temperature estimation in Lyon, France. This field test was done as a research item of Lyon Smart Community Project and the data were collected via HEMS we developed. On the other hand, we carried out an evaluation experiment for interruption control in space cooling using acceptable interruption time estimation in a Japan office. The results obtained in these field tests show that each method achieved more than 10% energy-saving rates. A part of the topics presented here was supported by New Energy and Industrial Technology Development Organization (NEDO) in Japan.

14.15

Kenichi Tokoro, Central Research Institute of Electric Power Industry, Energy Innovation Center
所 健一、電力中央研究所 エネルギーイノベーション創発センター

Optimal operation plan for an energy storage device and electricity demand estimation of an apartment house

In the presentation, we propose a method of determining the optimal operation plan of an energy storage device. The proposed method determines the lower limit of stored energy at each time by solving an optimization programming problem and we operate the energy storage device so as not to exceed the lower limit. In the numerical experiments, the proposed method reduces the electricity bill by 10% than the conventional method. Furthermore, we propose a method of estimating the whole electricity demand of an apartment house using the layout information of the apartment house. The proposed method estimates the demand based on the electricity consumption characteristics of the typical customer groups of each layout. We obtain the customer groups by classifying the customer data given as learning data. In the numerical experiments, the proposed method estimated the demand with an error of 25% or less.

15.00	Yoshiichi Tokuda, Sony Computer Science Laboratories 徳田 佳一、株式会社ソニーコンピュータサイエンス研究所 ***Sustainable Living Architecture as a Case Study of Horizontal Infrastructure*** Sustainable Development Goals(SDGs) have gotten a lot of attention recently. SDG-7, "affordable and clean energy" is one of the most closely related to our research. Talking about electricity access, about 1 billion people still lack access to modern electricity in developing countries. Conventional power grids can electrify urban areas efficiently, but not dispersed rural communities, so we think that we need innovative solutions of infrastructure to achieve the access in such areas. Sustainable Living Architecture(SLA) is one of solutions. We have made an empirical study of the SLA in Okinawa Institute of Science and Technology(OIST), and have implemented joint research of the integrated platform of energy and mobility, in particular, DCOES(DC based Open Energy System) and MIGEX (Microgrid with Exchangeable Batteries) since 2017, supported by the Okinawa Prefectural Government grant. We introduce and discuss the above project in the workshop.
15.30	DCOES/Misawa home tour
16.30	Prof. Junichi Murata, Kyushu University 村田純一教授、九州大学 ***Estimation of hidden objective functions of decision-makers using inverse reinforcement learning* 逆強化学習を用いた意思決定者の目的関数の推定** An approach will be discussed to estimation of hidden objective functions used in decision-making by humans. An electric power consumer will determine her/his power consumption based on his/her own objective functions. Knowing these objective functions will be much useful in demand side management. Unfortunately, however, these are not directly accessible. Directly measurable instead are the consumer's behavior. The decision-making process by the consumer is regarded as (approximate) optimization of his/her objective functions. We can measure the results of this optimization as the power consumption behaviors. In other words, we know the optimal solution. What we want to do is to estimate the objective functions that lead to this particular optimal solution. This process is termed as 'inverse optimization.' Unfortunately again, there are an infinite number of objective functions that give an identical optimal solution. In order to determine the functions uniquely, we have to make use of additional information. Inverse reinforcement learning is employed as a specific technique to solve the inverse optimization problem. Several formulations will be discussed and their advantages and disadvantages will be illustrated on a set of simulated demand response data.

17.00 Prof. Takaharu Ishida, Meisei University
石田 隆張教授、明星大学 理工学部 総合理工学科 電気電子工学系

EV smart charging method with the deterioration of the battery

Electric vehicle(EV) released from 2009 are gradually spreading. As for the battery mounted on EV, deterioration occurs in various factors every day, and the performance of the battery such as charging speed and controlling response may gradually decrease. On the other hand, a change of the accumulation of electricity capacity by the deterioration of the battery has an influence on the precision of a charge or discharge plan of EV or EV-based battery periodically in future.Therefore we have developed the simulator which we added a parameter about the deterioration of the EV-based battery which was not considered until now, and calculated a plan to inspect the above assumption in this report. It is promising that the proposed method improves the result of the discharge and charge plan calculation of EV in a charge plan of smart charging method scattering charge load of EV. In the following, we considered about the deterioration of the battery from the situation of the application development, and report the contents of the simulator which we have made from the result and developed and a screen example.

18.00 Dinner

Saturday, Jan 12th, 2019

10.00 Yu Shimizu, Integrated Open Systems Unit, OIST

Smart Grids and Stability - A Whole Year Evaluation of an Inhabited DC microgrid with Energy Exchange

We investigate the grid stability with respect to sustainability of an inhabited PV based DC microgrid, which allows for energy exchange among the peers. Located on the subtropical island of Okinawa, Japan, the microgrid is subject to yearly rainy season and typhoons. This offers a difficult, but at the same time ideal environment to study grid behaviour under strongly varying conditions. We present results from data obtained over a whole year, which gives insight into weather related energy production and consumption patterns and thus into affected self sufficiency. We introduce the Grid Independency Index (GII) and the Off Grid Time (OGT), which reflect independency of the community from the commercial grid and maximum time the whole community sustains itself on battery charge only, respectively. We compare these parameters to the amount of produced energy in comparison to the amount of used energy, the Off Grid Potential (OGP). Together, these three parameters give a good characterization of the grid sustainability. In their role as stability indicators they also point to elements of seasonal trend and necessary improvement in hardware as well as energy exchange algorithm in the system. We for example find the longest OGT during the moderately hot months, despite increasing OGP during summer. Similarly, GII increases in the hotter months, but hardly exceeds 55%. The cause of these phenomena lies in the temperature related increase in consumption, which also results in an increase of energy exchange and thus amplified system loss.

10.30	Kenichiro Arakaki, Integrated Open Systems Unit, OIST ***A Microgrid Simulation Software for DC-based Open Energy Systems – the DCOES Simulator*** A microgrid simulation software has developed for DC-based Open Energy Systems (DCOES), which allow for the exchange of energy between the prosumers. The DCOES simulation software examines and visualizes the effectiveness of energy usage in such dc microgrid community, providing a simple operation to build-up such a community by setting the resources of each house installed in the microgrid system. A simulation usually requires access to time-series data of photovoltaic (PV) production and household consumption. However, as real data is often unavailable, we implemented functions to estimate the PV production based on either satellite-derived solar radiation data from NASA POWER (Prediction Of Worldwide Energy Resources, POWER) project or ground-measured data. Consumption time-series can be generated based on several provided consumption patterns. Based on the community settings and time-series data, DCOES simulator simulates the microgrid controller in each house which negotiates the energy exchange according to individual house settings. Besides visualization of the resulting energy exchanges, the simulator returns grid related evaluation parameters such as self-sufficiency rate (SSR), battery state of charge (SoC) and surplus power for each house as well as of community-wide. By using this simulator, various microgrid constellations and exchange patterns can easily be compared, providing a basis for improvement, exploring and planning of new grid architecture.
11.00	Prof. Shiro Tamaki, Faculty of Engineering Department of Information Engineering, University of Ryukyu's 玉城史朗教授、琉球大学工学部情報工学科 **時空間ＩｏＴを基盤とした高品質果実栽培システムの開発** 施設園芸システムにおいてＩＣＴ，および、ＩｏＴ技術を導入して付加価値を高める試みは、これから始まったばかりである。本研究では、宮古島での実証試験を踏まえて、我々が開発した時空間ＩｏＴを基盤としたマンゴ生産システムについて説明する。特に、マンゴーの生育は気象条件に左右されやすいので、その環境パラメータをいかに制御するかについて考察する。さらには、マンゴーの等級判別法や、マンゴーの収量と気象条件についても述べる。
11.30	Coffee Break
11.45	第4回技術協同研究委員会
13.00	Lunch