COORDICY NEWS No. 4 - April 2017

SCHNEIDER ELECTRIC HAS JOINED THE COORDICY PROJECT

By October 1st Schneider Electric joined the COORDICY project as an affiliated partner. Schneider will contribute to the development of software for continues performance tests in building OU44 at SDU and to the application of Schneider Building Analytics software in building OU44.

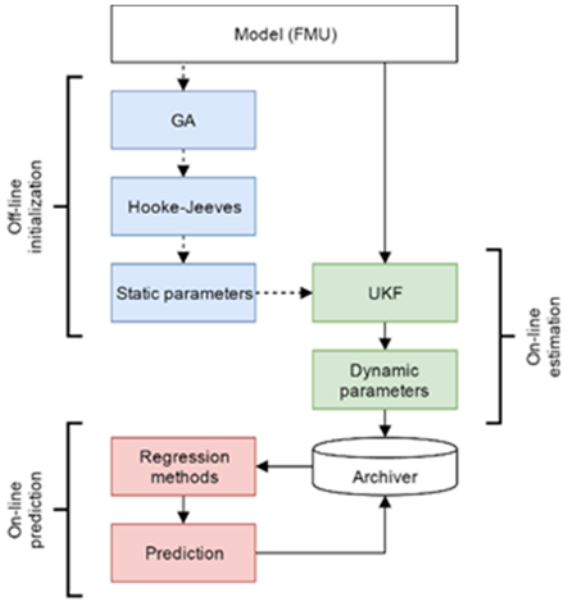
Schneider Electric is a large global company who specializes in building and energy management systems, security controls, energy and carbon dashboards, and building analytics. Read more about Schneider Electric at www.schneider-electric.com.

Due to changes at Insero they have chosen to withdraw from the COORDICY project and focus their efforts on other projects. PhD student Peter Nellemann is now employed at SDU, where he is continuing his work in COORDICY as planned.

UPCOMING WORKSHOPS

In week 22 at the end of May and beginning of June two workshop are planed for California. The first workshop will be held in Palo Alto together with Innovation Center Denmark and have a commercial focus. The second workshop will take place at UC Berkeley and focus on research. More information will be available soon.

KRZYSZTOF ARENDT IS CURRENTLY VISITING LBNL



Model estimation and prediction framework (MODEST)

Krzysztof is currently visiting the Simulation Research Group at LBNL. His 6-months long stay is focused on the system identification methods for Model Predictive Control (MPC) in buildings. He combines genetic algorithm, Hooke-Jeeves method, unscented Kalman filter, and machine learning algorithms to estimate static model parameters (e.g. material parameters of walls), dynamic model parameters (e.g. interzonal airflow), and to predict the future trajectories of these parameters. The framework being developed works with all models compliant with the Functional Mock-Up Interface.

The primary aim of the work is to increase the accuracy of the models used by Controleum to optimize building energy consumption. However, the framework can be used in a number of applications including general system optimization or estimation and prediction of unmeasured quantities in systems. The collaboration with the Simulation Research Group is valuable, as the group focuses experts in MPC and building simulation, and Krzysztof's work is largely based on or inspired by tools developed at LBNL.

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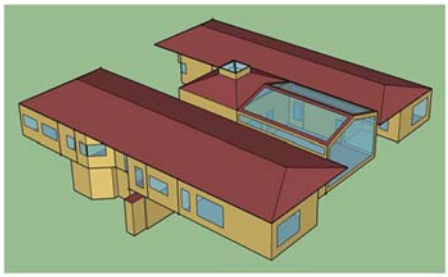
ELENA MARKOSKA AT UC BERKELEY AND LBNL IN THE SPRING

Following previous research that extended performance testing to the field of fault detection and diagnostics, Elena Markoska is going to further her efforts on the premises of LBNL and UC Berkeley. The new buildings offer a fresh perspective stemming from the variability of available buildings. A new mechanism is to be developed that intelligently chooses the performance tests applicable to a building, based on simply a metadata model. According to the metadata model, the performance testing framework will be able to find out which tests can be run on the building, and set up the configuration autonomously for their continuous future execution.

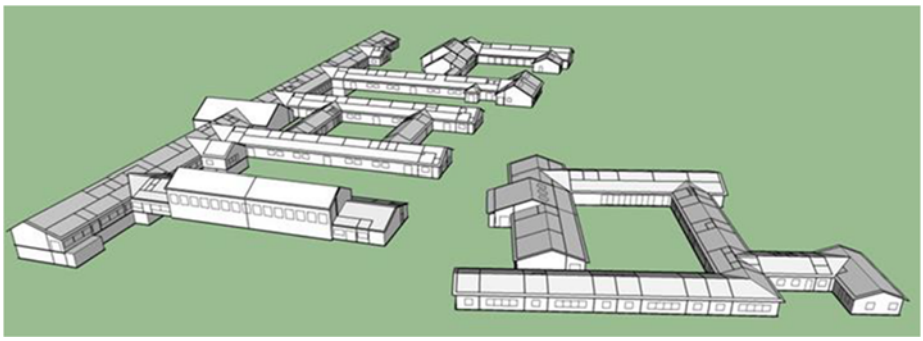
AARHUS DAYCARE CENTERS CASE STUDIES COMPLETED



The work on 4 case study buildings in Aarhus was completed, Bøgevangen 101, Runevej 107 -109, Hasselhaven 1, and Hasselhaven 3, in collaboration with the Municipality of Aarhus and the Danish Technological Institute (DTI). An overall methodology for buildings energy modeling, simulation, and energy renovation evaluation was developed and implemented in the 4 buildings. Based on multiple field visits to the buildings, components inspections, technical managers interviews, and users feedback, various energy renovation measures and packages were prioritized and evaluated using a holistic approach considering the technical, economic, and environmental impacts of each package. DTI has contributed through anthropologies studies carried out on 2 buildings by Sarah Gramstrup including interviews with the technical managers and feedback from the users. Findings and recommendations for buildings energy performance improvement and energy renovation were provided to the Municipality of Aarhus to support the decision making process to renovate the 4 daycare centers.

Student Assistants Kristian Emil Oxholm Bloch-Hansen and Casper Fälling Thielsen and Assistant Professor Muhyiddine Jradi, Center for Energy Informatics, SDU

KROGGÅRDSSKOLEN CASE STUDY COMPLETED



In collaboration with Odense Municipality and DTI, the work on Kroggårdsskolen was completed. A Revit 3D model was developed for the school with accurate representation of the geometry and construction characteristics. Onsite inspection has been conducted along with the Danish Technological Institute and data regarding the ventilation units and heating system was collected. In addition, DTI has conducted an anthropologic study on the school including interviews and observations, and a report regarding the occupancy and the school operation was provided. All these data and information were considered in developing the holistic energy model for the school, taking into account different school characteristics, constructions, specifications, schedules, and sub-systems. Using the developed model, multiple energy management and retrofit combinations were analyzed and evaluated for different school blocks. The economic and technical evaluation of the different measures were reported and favorable measures were recommended and highlighted.

Student Assistants Kristian Emil Oxholm Bloch-Hansen and Casper Fälling Thielsen and Assistant Professor Muhyiddine Jradi, Center for Energy Informatics, SDU

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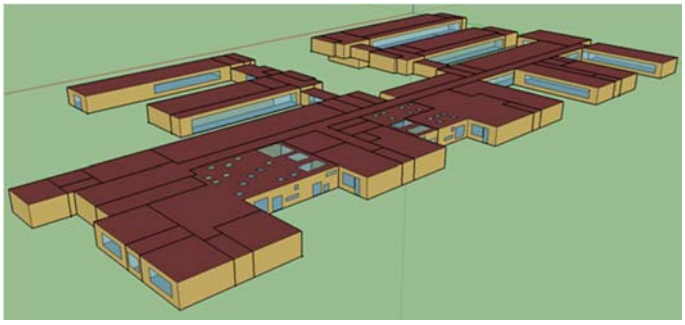
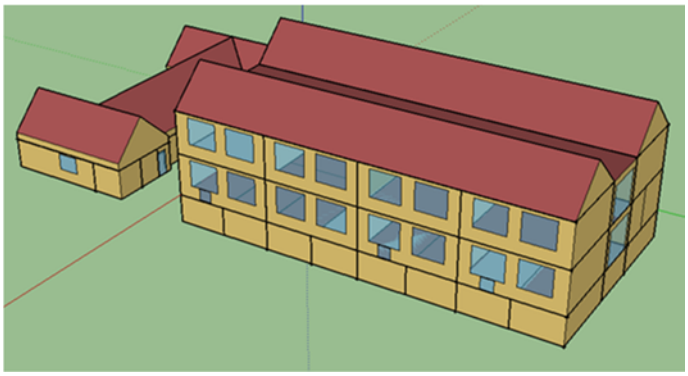
PÅRUP SCHOOL

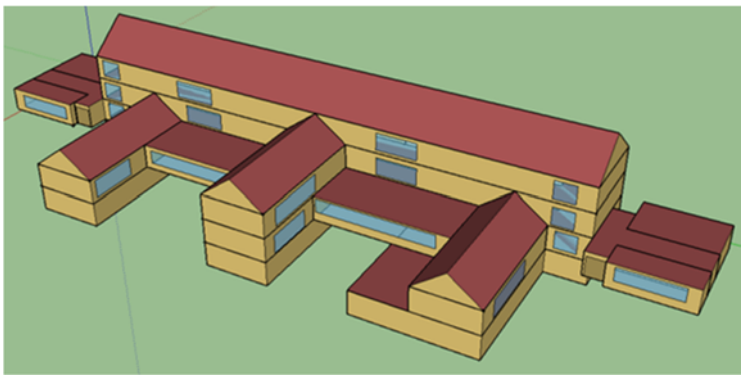


The work is underway for Pårup School as a case study in COORDICY, for energy modeling, simulation, and renovation assessment. A complete 3D model for the school was developed and the energy performance model is currently under development taking into account different information collected and various characteristics and specifications, aiming to investigate various options for the school performance improvement and energy renovation process.

Student Assistant Nikolaj Vinkel Hansen and Assistant Professor Muhyiddine Jradi, Center for Energy Informatics, SDU

EJERSLYKKESKOLEN

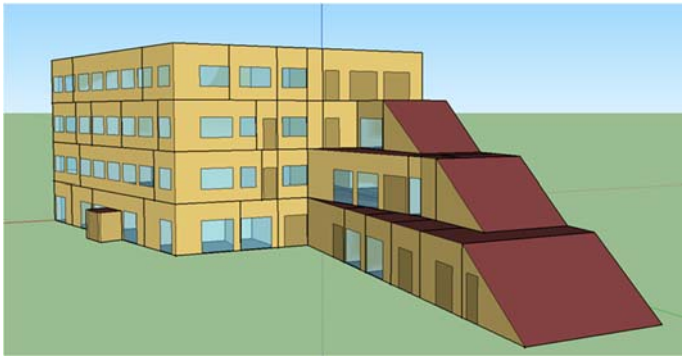




The 3D models of the different blocks at Ejerslykkeskolen were completed along with the detailed energy models. Performance simulations were carried out and different renovation measures were implemented in the school blocks. The final report on the school is currently being compiled. This work is carried out as a part of a final project under the course Building Energy Modeling and Simulation.

Supervised by Assistant Professor Muhyiddine and Postdoc Krzysztof Arendt

RESILIENCE HOUSE



The Resilience House in Vejle is another case study currently being investigated under the COORDICY project to develop the detailed energy performance model in addition to carry out an overall performance testing of various energy supply systems in the building and ensure that the building is performing in a proper manner. The building 3D model is completed and the energy model is currently developed considering different systems in the building including 2 heat pumps, PV units, and ground-source heating and cooling system. The building is going to be opened in July 2017.

Assistant Professor Muhyiddine Jradi and PhD student Elena Markoska, Center for Energy Informatics, SDU

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SUTARDJA DAI HALL

Sutardja Dai Hall building at the University of California, Berkeley is one of the COORDICY project case studies in the USA. A detailed EnergyPlus energy performance model was refined and upgraded taking into account building envelope, constructions, and energy supply systems specifications including heating and cooling system configurations. In the next phase, actual energy performance data along with simulation results will be used to apply automatic performance testing to monitor the building performance in terms of energy consumption and energy supply systems operation and to ensure that the building is performing in a proper manner.

Assistant Professor Muhyiddine Jradi and PhD student Elena Markoska, Center for Energy Informatics, SDU

BACHELOR THESIS ON THE PERFORMANCE MODELING, SIMULATION, AND ENERGY RENOVATION OF SEDEN SCHOOL

The main aim of this project is to develop a holistic energy performance model to predict the overall energy performance of the building blocks at Seden school through a computer-based model that represents all the energy processes within a building that are intended to provide a comfortable environment for the occupants, using Sketchup, Open Studio, and EnergyPlus tools. Based on the building energy performance model developed, energy renovation techniques will be suggested to improve the energy performance of the school buildings taking into account the technical and economic impacts. Seden School is another case study building considered under the COORDICY project.

Bachelor Students Rasmus Camillus Jeppesen and Henrik Engelbrecht Foldager
Supervisor: Assistant Professor Muhyiddine Jradi, Center for Energy Informatics, SDU

BRICK - A UNIFORM METADATA SCHEMA FOR BUILDINGS

Commercial buildings have long since been a primary target for applications from a number of areas: from cyber-physical systems to building energy use to improved human interactions in built environments. While technological advances have been made in these areas, such solutions rarely experience widespread adoption due to the lack of a common descriptive schema reducing the now-prohibitive cost of porting these applications and systems to different buildings.
Brick is an open-source, BSD-licensed development effort to create a uniform schema for representing metadata in buildings. Brick has three components:

- An RDF class hierarchy describing the various building subsystems and the entities and equipment therein
- A minimal, principled set of relationships for connecting these entities together into a directed graph representing a building
- A method of encapsulation for composing complex components from a set of lower-level ones

Additionally, we have ported five real buildings to the Brick schema as examples.

For more information please visit: http://brickschema.org/

Arka Bhattacharya, Gabriel Fierro, and David Culler, UC Berkeley
Aslak Johansen and Mikkel Baun Kjærgaard, Center for Energy Informatics, SDU

SEE THE WORLD IN A NEW WAY: OPTIMIZE YOUR BUILDING WITH PREDICTABLE CONTROL AND OPERATION

This was the title of a speech given by professor MSO Christian Veje from SDU and Business Development Director Niels Boel from Schneider Electric at Energiforum in March. Energiforum is a conference held by Energiforum Denmark focusing on many aspects of the energy field, i.e. the political aspect, new technologies, new ways, and networking. Christian and Niels presented the COORDICY project and the interesting results that has been reached so far.

RESEARCH PUBLICATIONS

1. B. Balaji, A. Bhattacharya, G. Fierro, J. Gao, J. Gluck, D. Hong, A. Johansen, J. Koh, J. Ploennigs, Y. Agarwal, M. Berges, D. Culler, M.B. Kjærgaard, R. Gupta & K. Whitehouse: Brick: Towards a Unified Metadata Schema For Buildings. In: Proceedings of the 3rd ACM International Conference on Systems for Energy-Efficient Built Environments (BuildSys '16), November 15-17, 2016, Palo Alto, USA, p. 41-50.

2. B. Balaji, A. Bhattacharya, G. Fierro, J. Gao, D. Hong, A. Johansen, J. Koh, J. Ploennigs, Y. Agarwal, M. Berges, D. Culler, R. Gupta, M.B. Kjærgaard & K. Whitehouse: Demo Abstract – Portable Queries Using Brick Schema for Building Applications, Proceedings of the 3rd ACM International Conference on Systems for Energy-Efficient Built Environments, 2016, p. 219-220.

3. E. Markoska, M. Jradi & B.N. Jørgensen: Continuous commissioning of buildings: A case study of a campus building in Denmark. In: Proceedings of the 9th IEEE International Conference on Cyber, Physical, and Social Computing (CPSCom 2016), 16-19 December 2016, Chengdu, China, p. 584-589.

4. J. Al-Jaroodi, N. Mohamed, I. Jawhar, and S. Lazarova-Molnar, "Software Engineering Issues for Cyber-Physical Systems," in 2016 IEEE International Conference on Smart Computing (SMARTCOMP), St. Louis, Missouri, USA, 2016, p. 1-6.

5. M.B. Kjærgaard, K. Arendt, A. Clausen, A. Johansen, M. Jradi, B.N. Jørgensen, P. Nellemann, F.C. Sangogboye, C.T. Veje & M.G. Wollsen: Demand Response in Commercial Buildings with an Assessable Impact on Occupant Comfort, Proceedings of 2016 IEEE International Conference on Smart Grid Communications - Sydney, Australien, p. 447-452.

6. M.B. Kjærgaard & F.C. Sangogboye: Categorization Framework and Survey of Occupancy Sensing Systems, Elsevier Journal of Pervasive and Mobile Computing (PMC), 2016

7. M.G. Wollsen, J. Hallam, & B.N. Jørgensen: Novel Automatic Filter-Class Feature Selection for Machine Learning Regression. In: Proceedings of the INNS Conference on Big Data, 23-25 October, Thessaliniki, Greece, 2016. Advances in Big Data, Advances in Intelligent Systems and Computing, Vol. 529, Springer, p. 71 - 80.

8. N. Mohamed, S. Lazarova-Molnar, and J. Al-Jaroodi, "CE-BEMS: A cloud-enabled building energy management system," in 2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC), Muscat, Oman, 2016, p. 1-6.

9. N. Mohamed, S. Lazarova-Molnar, and J. Al-Jaroodi, "SBDaaS: Smart building diagnostics as a service on the cloud," in The 2nd International Conference on Intelligent Green Building and Smart Grid (IGBSG), Prague, Czech Republic, 2016, p. 1-6.

RESEARCH PUBLICATIONS

10. N. Mohamed, J. Al-Jaroodi, S. Lazarova-Molnar, and I. Jawhar, "Middleware to support cyber-physical systems," in 2016 IEEE 35th International Performance Computing and Communications Conference (IPCCC), Las Vegas, NV, USA, 2016, p. 1-3.
11. S. Lazarova-Molnar and H. R. Shaker, "A Conceptual Framework for Occupant-Centered Building Management Decision Support System," in 12th International Conference on Intelligent Environments, London, United Kingdom, 2016, p. 436-445.
12. S. Lazarova-Molnar, H. R. Shaker, and N. Mohamed, "Reliability of cyber physical systems with focus on building management systems," in 2016 IEEE 35th International Performance Computing and Communications Conference (IPCCC), Las Vegas, NV, USA, 2016, p. 1-6.
13. S. Lazarova-Molnar, H. Þ. Logason, P. G. Andersen, and M. B. Kjærgaard, "Mobile Crowdsourcing of Data for Fault Detection and Diagnosis in Smart Buildings," in Proceedings of the International Conference on Research in Adaptive and Convergent Systems, Odense, Denmark, 2016, p. 12-17.

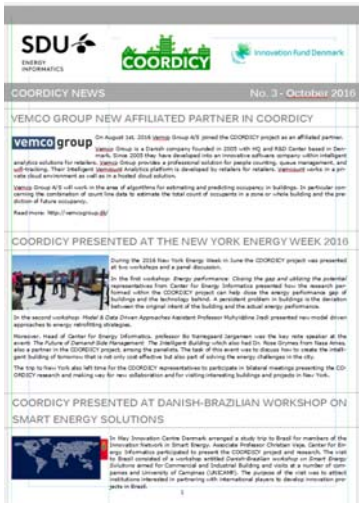
BACHELOR PROJECTS AND MASTER'S THESES

1. H.Þ Logason and P.G. Andersen: Mobile Crowdsourcing of Data for Fault Detection and Diagnosis in Smart Buildings, Bachelor Project, MMMI, University of Southern Denmark, 2016 Advisor: Associate Professor Sanja Lazarova-Molnar
2. K.E.O. Bloch-Hansen and C.F. Thielsen: "Improving the overall energy performance of day-care centers in Aarhus: Bøgevangen 101 and Runevej 107-109 Case", Bachelor Project, MMMI, University of Southern Denmark, Odense 2016. Advisor: Assistant Professor Muhyiddine Jradi
3. J.H. Schwee & D.H.E. Olsen, "Visualisering af sensor data på interaktive 2D kort", Bachelor Project, MMMI, University of Southern Denmark, Odense, 2016, Advisor: Associate Professor Mikkel Baun Kjærgaard
4. N.V. Hansen: "Energy performance simulation and optimization of two day care centers in Aarhus: Hasselhaven 1 and 3" Bachelor Project, MMMI, University of Southern Denmark, Odense 2016. Advisor: Assistant Professor Muhyiddine Jradi.
5. S. Egedorf - "Adverse Condition and Critical Event Prediction in Smart Commercial Buildings", Master Thesis, MMMI, University of Southern Denmark, Odense, 2016, Advisor: Associate Professor Hamid Reza Shaker
6. S. Köycu and A. Akhmiev - "Automatiseret personlig lysstyring via smartphones", Master Thesis, MMMI, University of Southern Denmark, Odense, 2016, Advisor: Associate Professor Mikkel Baun Kjærgaard
7. S. Rasmussen, "Performance test af tidsseriedatabase til sensor data" Bachelor Project, MMMI, University of Southern Denmark, Odense, 2016, Advisor: Associate Professor Mikkel Baun Kjærgaard

COORDICY IN THE MEDIA

"Få tal på brugerne via Sensorteknologi " HVAC Magasinet nr. 10, Oktober 2016

CONCLUDING REMARKS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COORDICY NEWS No. 3 - October 2016

VEMCO GROUP NEW AFFILIATED PARTNER IN COORDICY

vemco group

COORDICY PRESENTED AT THE NEW YORK ENERGY WEEK 2016

COORDICY PRESENTED AT DANISH-BRAZILIAN WORKSHOP ON SMART ENERGY SOLUTIONS

Sarah Gramstrup anthropologist from DTI will start maternity leave in May and will not return to the COORDICY project afterwards. Thank you Sarah for your effort in the project.

The next newletter will be in October 2017. If you have any input for the next newsletter please contact Heidi Maglekær Jensen phone +45 65 50 35 48 or e-mail: hmje@mmmi.sdu.dk. Any input must be handed in before September 1st, 2017.