

48-721 BUILDING CONTROLS AND DIAGNOSTICS (BCD)

Students' theoretical knowledge on energy and environmental performance assessment methods are leveraged with the hands-on approach of the BCD course which addresses research-grade concepts of building controls and diagnostics through actual building case studies and the application of field measurement techniques. Special emphasis is given to empirical evaluation of the performance of the built environment and systems by considering interactions with occupants with regard to multiple environmental performance criteria (thermal-visual-acoustics). With the BCD course, students acquire necessary skills to develop interactive web-sites with dashboards to demonstrate building energy systems and their dynamic performance, conduct Post-Occupancy Evaluation and Measurement (POE+M) studies, develop advanced building system control logics and algorithms, create virtual prototypes of these controls systems, test them on actual building cases (e.g., The Intelligent Workplace of the SoA, CMU, the Center for Sustainable Landscapes of the Phipps Conservatory and Botanical Gardens) through the use of cutting-edge data processing techniques. Theoretical lectures of this course include basic refreshers of building physics concepts, thermodynamics and heat transfer mechanisms, human thermal-visual and acoustical comfort as well as mechanical-electrical building systems with focus on optimized operational sequences. The BCD course puts emphasis on empirical methods of building analysis not only to describe/specify building components (mostly active ones) but also to study their real-time/operational behavior. Physical sensor networks are interfaced with their virtual counterparts using the Labview platform (Laboratory Virtual Instrument Engineering Workbench) and necessary numerical modeling and control design algorithm developments are supported with Matlab platform. These two programs are introduced to the students with well-balanced level of details. Graduate students who are interested in researching the advanced building control systems have a solid foundation with the BCD course which introduces state-of-the-art control methods (such as model based predictive controls with deep reinforcement learning) in addition to conventional approaches (such as rule-based or proportional-integral-derivative (PID) controls). Selected environmental performance measurement approaches are demonstrated along with the introductions of contemporary design and operational control techniques for environmentally responsive, energy efficient and healthy buildings.