香港城市大學
City University of Hong Kong

# Virtual and physical integrated laboratory teaching for improved learning of complex building engineering courses

**Project Number:** 6000860

**Principal Investigator:** Prof. Yongjun SUN

**Grant Type:** TDG

**Abstract:**

Laboratory teaching provides first-hand experience in observation, and it is superior to other methods of developing students' understanding and appreciation. Building engineering courses (e.g., thermodynamics, fluid mechanics) involving many abstract and complex concepts, equations and theories, and thus associated laboratory teaching plays an important role in improving students' learning effects of such courses.

Existing laboratory teaching is solely physical-based, and it suffers from the following key limitations. First, due to extremely limited space and/or critical safety concerns (e.g., fire related safety requirements), some important teaching platforms cannot be physically established and thus associated laboratory teaching will be not available. Second, considering the massive costs and complexities of constructing real system-level platforms, local universities frequently oversimplified the platforms, resulting in reduced observations of complex system-level processing/variations and thus decreased learning effects. Third, updating a physical platform is usually costly and time-consuming, and thus many existing platforms have not been updated for a long term or even become outdated, disconnecting our students' learning from the emerging technologies. On the other hand, compared with the physical platforms, virtual platforms can provide more flexible hands-on experience while require much less on cost, space, and safety issues. Therefore, there exists an opportunity to integrate associated virtual and physical laboratory teaching for improved learning effects of complex building engineering courses.

To achieve the aim, this project will take the laboratory teaching course CA3722 (of which the PI is the course leader) as an example, develop interactive virtual platforms to assist the existing physical platforms' teaching, implement the integrated teaching mode in practice, and evaluate the integrated teaching mode by comparing with the conventional physical mode. Utilizing visualization enabled software (e.g., Tableau, TRNSYS and MATLAB), we will develop the interactive virtual platforms to provide students more real-system-like observations and hands-on experiences that are not available from the current simplified physical platforms. Together with the physical platforms, the virtual platforms will help provide our students easy, fast and accurate understanding of those abstract and complex concepts, equations and theories in these courses.

If succeed, the project may provide a novel laboratory teaching with improved learning effects that is especially suitable for local universities with limited space and harsh safety concerns.