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Real-time virtual sensor with physics-driven digital twin: theory and application

Associate Professor Jin-Gyun Kim

Department of Mechanical Engineering, Kyung Hee University

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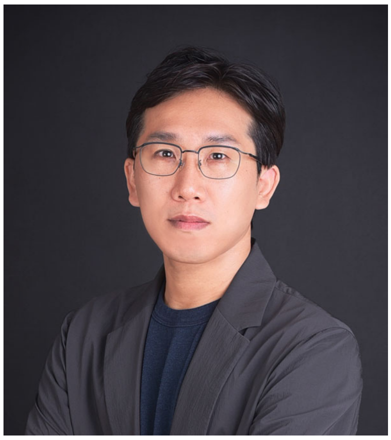
Venue：Faculty of Engineering Bldg. 2, Room 31A

Abstract:

It becomes essential to collect large amounts of quantitative and highly qualitative data. However, in real engineering environment, there are a lot of difficulties: (1) limitation of sensor attachment, (2) limitation of the number of sensors, (3) measurement noise cancellation, etc. Virtual sensor is a robust way to reinforce unmeasured data that is difficult to obtain experimentally. The digital twin then plays a key part in the virtual sensing framework to replicate highly accurate data. In this work, a real-time virtual sensing framework with physics-driven digital twin is introduced. Finite element (FE) model with reduced order modeling and its model updating are used to define the digital twin. Input sources, which are external forces or heat flux depending on certain problems, are also indirectly defined by using inverse source identification. Then, utilizing the digital twin model and estimated input sources, other desirable but unmeasured data can be replicated. It can be effectively achieved by using the proposed virtual sensing framework connected to real experimental test beds. Two different virtual sensors, structural vibration and heat transfer, along with their theories and applications, are covered in this presentation. In addition, its potentials for multibody and/or flexible multibody dynamics are discussed with recently developed machine learning-based approaches.



Associate Professor Jin-Gyun Kim

Department of Mechanical Engineering,
Kyung Hee University

主催：　東京大学大学院工学系研究科専攻間横断型教育プログラム 機械システム・イノベーション（GMSI）
未来社会協創国際卓越大学院（WINGS CFS）
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本件連絡先：　東京大学大学院工学系研究科機械工学専攻　講師　木崎　通
GMSI事務局　E-mail: office@gmsi.t.u-tokyo.ac.jp　Phone: 03-5841-0696