

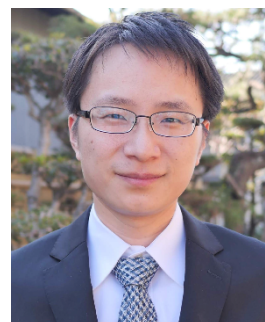
IEEE CSS Kansai Chapter Special Lecture on CSS Day 2022

Time and Date: 17:00-18:00, October 19, 2022 (JST)

Format: Online Zoom Meeting

Speaker: Prof. Kai Cai (Osaka Metropolitan University)

Title: Congruences and Quotients: A Model-Independent Structural Approach in Systems and Control



Abstract: An effective approach to understanding large complex dynamic systems is to reduce their sizes, or decompose their monolithic structures into simpler components. In this talk, we introduce an algebraic framework for property-preserving structural reduction and decomposition based on *congruences*, i.e. binary relations that respect system dynamics. Given a dynamic system with a property of interest, we construct a congruence for the property and show that the corresponding *quotient* yields a reduced or decomposed structure which preserves that property. We illustrate the generality of this framework with two existing methods: bisimulation based abstraction in hybrid control and supervisor localization in discrete-event systems. Finally we introduce an application of this framework in cyber-physical control of multi-robot systems.

Bio: Kai Cai received the B.Eng. degree in Electrical Engineering from Zhejiang University, Hangzhou, China, in 2006; the M.A.Sc. degree in Electrical and Computer Engineering from the University of Toronto, Toronto, ON, Canada, in 2008; and the Ph.D. degree in Systems Science from the Tokyo Institute of Technology, Tokyo, Japan, in 2011. He is currently a Professor at Osaka Metropolitan University. Previously, he was an Associate Professor at Osaka City University (2014-2020), an Assistant Professor at the University of Tokyo (2013-2014), and a Postdoctoral Fellow at the University of Toronto (2011-2013).

Dr. Cai's research interests include discrete-event systems, cyber-physical systems, and networked multi-agent systems. He is the co-author (with W.M. Wonham) of *Supervisory Control of Discrete-Event Systems* (Springer 2019) and *Supervisor Localization* (Springer 2016). He is serving as the Chair for the IEEE CSS Technical Committee on Discrete Event Systems and an Associate Editor for the *IEEE Transactions on Automatic Control*. He was the recipient of the Pioneer Award of SICE in 2021, the Best Paper Award of SICE in 2013, and the Best Student Paper Award of the IEEE Multi-Conference on Systems and Control in 2010.