Multiscopic Topological Twin in Trailer Living Laboratory

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Abstract: Recently Cyber-Physical Systems, Digital Transformation, and Digital Twin have been discussed towards the digitalization of service to people thanks to the integration of information, intelligence, communication, and robot technologies. topological structure is useful to extract features from given or measured big data and to simulate a real-world phenomenon in such a cyber world. Therefore, we proposed the concept of *topological twin*. The aim of topological twin is to (1) extract topological structures hidden implicitly in the real world, (2) reproduce them explicitly in the cyber world, and (3) simulate and analyze the real world in the cyber world. The topological twin plays the important role in extracting and connecting structures hidden in real world from the mutliscopic point of view. In this talk, we discuss the concept of topological twin for sophisticated service to people in order to bridge the cyber-physical gap from the multiscopic point of view. First, we discuss the role of trailer living laboratory as a new style of smart home in the future society. We can bring the trailer living laboratory to elderly houses, hospitals, and public spaces, and discuss the co-creation towards open innovation using daily life settings with multi-stakeholder approach. Next, we explain various types of topological mapping methods, unsupervised learning methods, and graph-based methods as the methodology of topological intelligence. One of them is Growing Neural Gas (GNG) that can dynamically change the topological structure composed of nodes and edges. We have proposed various types of methods based on multi-scale batch-learning GNG called Fast GNG. Next, we show the comparison result of Fast GNG with other methods. Furthermore, we show several experimental results of multiscopic topological twin in the trailer living laboratory. Finally, we discuss the future direction of researches on the multiscopic topological twin.

Biography:

Naoyuki Kubota is currently a Professor in the Department of Mechanical Systems Engineering, the Graduate School of Systems Design, and Director of Community-centric Systems Research Center, Tokyo Metropolitan University, Japan. He graduated from Osaka Kyoiku University, Japan in 1992, received a master's degree from Hokkaido University, Japan in 1994, and received a doctoral degree from Nagoya University, Japan, in 1997. He was an Assistant Professor and Lecturer at the Department of Mechanical Engineering, Osaka Institute of Technology, Japan, from 1997 to 2000. In 2000, he joined the Department of Human and Artificial Intelligence Systems, the School of Engineering, Fukui University, Japan, as an Associate Professor. He joined the Department of Mechanical Engineering, the Graduate School of Engineering, Tokyo Metropolitan University, Japan, as an Associate Professor in 2004. He was an Associate Professor from 2005 to 2012, and a Professor from 2012 at the Graduate School of Systems Design, Tokyo Metropolitan University, Japan. He was a Visiting Professor at University of Portsmouth, UK, in 2007 and 2009, and was an Invited Visiting Professor at Seoul National University from 2009 to 2012, and others. His current interests are in the fields of topological mapping, coevolutionary computation, spiking neural networks, perception-based robotics, robot partners, and informationally structured space. He has published more than 500 refereed journal and conference papers in the above research fields. He received the Best Paper Award of IEEE IECON 1996, IEEE CIRA 1997, MHS 2011, WAC 2012, HSI 2016, and so on. He was an associate editor of the IEEE Transactions on Fuzzy Systems from 1999 to 2010, the IEEE CIS Intelligent Systems Applications Technical Committee, Robotics Task Force Chair from 2007 to 2014, IEEE Systems, Man, and Cybernetics Society, Japan Chapter Chair from 2018 to 2021, Vice Director, Tokyo Biomarker Innovation Research Association, Japan since 2020, and others.