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Pattern Formation in Skin Diseases and Its Application to Personalized Treatment in Dermatology
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Abstract: Skin diseases typically appear as visible information-skin eruptions distributed across the body. However, the biological mechanisms underlying these manifestations are often inferred from fragmented, time-point-specific data such as skin biopsies. The challenge is further compounded for human-specific conditions like urticaria, where animal models are ineffective, leaving researchers to rely heavily on in vitro experiments and sparse clinical observations.

To overcome the current limitations in understanding the pathophysiology of skin diseases, we propose a novel framework that connects the visible morphology of skin eruptions with the underlying pathophysiological dynamics in vivo, using a multidisciplinary approach that integrates mathematical modeling, in vitro experiments, clinical data, and data science. Furthermore, we will introduce an innovative methodology that combines mathematical modeling with topological data analysis and machine learning, allowing for the estimation of patient-specific parameters directly from morphological patterns of skin eruptions. This framework offers a new pathway for personalized analysis and mechanistic insight into complex skin disorders.

Bio: Prof. Seirin-Lee is a Professor of Mathematical Medicine at the Kyoto University Institute for Advanced Study (KUIAS) and the Graduate School of Medicine, Kyoto University. She obtained her PhD from Okayama University, Japan in 2010, having conducted part of her doctoral research at the Center for Mathematical Biology, University of Oxford, as a JSPS DC1 fellow. After postdoctoral training at the University of Tokyo and RIKEN, she was appointed Assistant Professor in 2014, Associate Professor in 2017, and Full Professor in 2020 at Hiroshima University. Since 2021, she has held her current position at Kyoto University. Her research focuses on pattern formation, mathematical medicine, mathematical dermatology, spatial immunology, and applied mathematics.

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