Mini-workshop

时间: 2024年7月2日

活动地点：光华东主楼2201

活动安排：

报告1. 题目：**Topological deep learning: The past, present, and future**

摘要：In the past few years, topological deep learning (TDL), a term coined by us in 2017, has become an emerging paradigm in artificial intelligence (AI). TDL is built on persistent homology (PH), an algebraic topology technique that bridges the gap between complex geometry and abstract topology through multiscale analysis. While TDL has made huge strides in a wide variety of scientific and engineering disciplines, its most compelling success was observed in biosciences with intrinsically high dimensional and intricately complex data. I will discuss the limitations and challenges of TDL. I will also discuss how algebraic topology is enabling AI and how AI is assisting topological reasoning.

报告人：Professor Guo-Wei Wei (Michigan State University)

A person wearing glasses and a white shirt

Description automatically generated with low confidenceGuowei Wei received his Ph.D. degree from the University of British Columbia and is currently an MSU Research Foundation Professor at Michigan State University. He has pioneered novel computational methods that integrate profound mathematical structures with deep learning, leading to victories in D3R Grand Challenges, a worldwide competition series in computer-aided drug design, and the discovery of SARS-CoV-2 evolutionary mechanisms. He has earned numerous awards and honors, including the elected fellow of AIMBE. In addition, he has partnered with world premier pharmaceutical companies and the U.S. Food and Drug Administration (FDA) on drug discovery. Dr. Wei has served extensively on various national and international panels, committees, and journal editorships. Many of his former trainees now hold faculty positions in research universities worldwide.

时间：2024年7月2日上午10：00--11：00

报告2. 题目：**腧穴——三维结构的拓扑学分析**

摘要：腧穴和经络在机体调节、整合和反馈中起重要作用。用前沿的全身透明、靶点分子成像和空间拓扑建模相结合的方法，研究阐述体表穴位和经络与内脏器官、系统间的联系和调控，为研究疾病变化和治疗转归等提供结构基础和科学依据。为揭示腧穴三维结构的特异性，我们综合利用了组织透明化三维成像和近红外II区活体成像技术，对小鼠任经及其上的四个穴位（阴交、石门、关元、中级）进行了成像研究。在精准定位和分层建模的基础上，与非穴位相比，腧穴具有更多的微血管分支和交感神经-血管耦合；而分支和耦合的结构特征与血流动力学和生物信号传递效率相关，进一步的TDA和Mapper拓扑分析表明，越接近腧穴生物信号传递时遇到的血管分叉越少，且腧穴的拓扑结构内部交叉点较少，意味其交感神经-血管耦合的空间结构越紧密，具有放大增幅的潜能。此外，为验证离体三维结构的生物学效应，基于近红外II区活体探针 LZ-1105的高分辨率体内实时血管成像表明，手针或电针均能引起关元穴相较于非腧穴区明显的血流增加，且电针相较于手针引起的血流增加幅度更大，持续时间更长；同时，去卵巢小鼠模型中连续三次电针关元穴的即时生理效应表现出对生殖功能的明显改善。综上，我们通过对腧穴神经血管的三维拓扑学研究，揭示其潜在的结构特异性和生物信号的“放大”潜能，从而为针刺治疗提供特定的物质基础和科学依据。

报告人：冯异教授（复旦大学中西医结合系）

时间：2024年7月2日下午14：00--15：00

报告3. 题目：Graphs with nonnegative Ollivier curvature and harmonic functions

摘要：Ollivier curvature is a discrete analog of the Ricci curvature on graphs. We prove that the number of ends of an infinite graph with nonnegative Ollivier curvature is at most two. Moreover, we prove a rigidity result that if a graph has nonnegative Ollivier curvature, which is isomorphic to a grid graph up to a finite perturbation, then it is the grid graph.

报告人：Professor Bobo Hua (Fudan University)

时间：2024年7月2日下午15：30--16：30