

## Report of KU-UNIVIE Joint Grant Program

### Section 1

<b>Project title:</b>		Mathematical models of emergence and dynamics of natural networks
<b>Project coordinator (KU)</b> Name Position Faculty, department		Prof. Sungrim Seirin-Lee Professor ASHBi, KUIAS, Faculty of Medicine
<b>Project coordinator (UNIVIE)</b> Name Position Faculty, department		Prof. Sara Merino-Aceituno Associate Professor Faculty of Mathematics
<b>Period of project</b>		From: November 2022 To: March 2023
<b>Project location</b>		KU: <input type="checkbox"/> UNIVIE: <input checked="" type="checkbox"/> Other:
<b>Approx. number of participants</b>	<b>For events<sup>*1</sup></b> (e.g. workshops, seminars, symposia)	[KU] Faculty members: 3 Students: Others: [UNIVIE] Faculty members: 3 Students: 2 Others: Other institutions: 6 *Please attach a participant list if possible. (the list will NOT be publicized) (see participant list attached)
	<b>For other exchange activities</b> (such as researcher visits and online meetings) <sup>*2</sup>	[KU] Faculty members: 3 Students: Others: [UNIVIE] Faculty members: 1 Students: 1 Others: Other institutions:
<b>If applicable: URL at which project outcomes can be viewed (e.g. workshop notifications/programs/reports, evidence of academic papers published or otherwise made available, etc.)</b>		<a href="https://ps-mathematik.univie.ac.at/e/index.php?event=kyoto2022">https://ps-mathematik.univie.ac.at/e/index.php?event=kyoto2022</a>
<b>If available: Photographs with captions</b>		

\*1 Please enter the number of participants for each event.

\*2 Please count each individual participant once only, even if they participate multiple times.

## Section 2

**Summary of the project (approx. 200 words)**

\*KU project coordinators are required to submit a summary of the project in Japanese in addition to the English summary (approx. 400 characters).

The goal of this project is to decipher using mathematical models the complexity of the living world. One of our motivating questions is the emergence and plasticity of self-organized complex structures such as large-scale networks which appear in a variety of biological systems: for instance, the pheromone trails created by ant colonies, the respiratory network in our body or the fiber networks that guide cell migration during development. Over the last decades, questioning the mathematical structure of biological systems has become a challenging but fruitful objective for both communities and within each one. Although important progress has been made recently in the mathematical community to find and design the good tools to apprehend the structural and dynamical complexity of biological systems, this task still remains at its infancy.

Since this project gathers applied mathematicians and biologists with different backgrounds, one of our first activities was to organize an interdisciplinary workshop where each group had the opportunity to present and confront its research problems, methodology and viewpoints. During this event various paradigms and current trends in mathematical biology have been discussed, including agent-based modelling, continuum modelling methods or *in silico* modelling.

This workshop was held within the thematic program “Mathematical Methods for the Study of Selforganization in the Biological Sciences” at the Erwin Schrodinger institute. This was the opportunity for researchers from Kyoto to visit and discover the research landscape in Vienna as well as to take the time to discuss to create new collaborations and foster existing ones.

Future collaborations are already scheduled, including research visits of Viennese members to Kyoto as well as the co-supervision of a new master student on the topics discussed during this initial meeting.

本計画の目的は数理モデルを用いて実現象の複雑性を理解し、解明することである。蟻のコロニーが作るフェロモン・トレイル、人体の呼吸器のネットワーク、細胞運動を導くファイバーネットワークなど、様々な生命系に現れる大規模ネットワークに基づく複雑な自己組織化の発現と多様性を理解し、その背景にある仕組みの解明を目指す。近年、生命現象に現れる数理的構造の解明は、生物学と数学の両分野において挑戦的な課題であり、融合的アプローチが重要となっている。それ故、生命系の構造的・力学的複雑性を理解するための数理的手法の開発や融合的研究の設計が急がれる。

本計画では様々な学問的背景を持つ応用数学者と生物学者が集まり、シーズを生み出す活動としてそれぞれの分野の研究者らの最先端の研究成果や方法論などについて発表を行い、異分野間のネットワークを構築できるワークショップの開催を行った。本ワークショップでは、エージェントベースモデリングや連続系の数理モデリング、実験データに基づく *in silico* モデリングなどの様々な数理的手法と最先端の研究課題が議論された。

本ワークショップは「Mathematical Methods for the Study of Self-organization in the Biological Sciences」というテーマで、Erwin Schrödinger instituteにて開催し、京都大学の研究者らがViennaを訪問して研究機関を視察することで、既存の共同研究の発展に加え、新しい共同研究についてシーズを生み出せるような十分な議論を行うことができた。また、引き続き共同研究を続けることを計画しており、Viennaの研究者による京都への訪問を予定している。今回のワークショップの参加で議論した新しい研究テーマにおいては、学生の共同指導など通じて引き続き議論を深めていく予定である。