Personal details

- Surname: Hagolani
- First names: Pascal Felix
- ORCID: 0000-0002-0603-8734
- Citizenship: Germany
- Permanent resident: Finland

Contact information

- E-mail: pfhagolani@gmail.com
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Degrees

- 04.10.2021. Doctor in Philosophy. Biological and Environmental Sciences. University of Helsinki. Helsinki, Finland. registrar@helsinki.fi
- 11.09.2013. Bachelor in Biology. Universidad de Granada. Granada, Spain.

Linguistic skills

- Mother tongue: Spanish, German
- Other languages: English (full professional)

Work experience

01.03.2024 - 31.01.25. Postdoctoral Researcher at Gulf University for Science & Technology under Dr. Kamaludin Dingle, investigating fundamental questions at the intersection of evolutionary biology and theoretical mathematics. My research addresses a central paradox in evolutionary biology: the unexpected success of statistical models in quantitative genetics at predicting long-term evolutionary outcomes, despite theoretical work suggesting these predictions should be substantially less reliable. I use computational models of tooth development as a concrete system to empirically test quantitative genetics predictions. This work combines developmental modeling with statistical approaches to systematically identify the conditions under which quantitative genetics successfully predicts evolutionary trajectories, and when these predictions break down. This investigation provides crucial insights into the robustness and limitations of current evolutionary theory. In parallel, I apply concepts from Algorithmic Information Theory to analyze complex biological systems. This approach establishes theoretical bounds on the complexity that can emerge within specific temporal constraints. By bridging information theory and evolutionary biology, this research contributes to our fundamental understanding of how biological complexity evolves and what theoretical limits might constrain this evolution. This work synthesizes concepts from developmental biology, evolutionary theory, statistics, and information theory, demonstrating the power of interdisciplinary approaches in addressing fundamental questions in biology.

01.06.2021 - 30.02.2024. Postdoctoral Researcher under Drs. Marie Semón and Sophie Pantalacci at the École Normale Supérieure de Lyon, France, investigating fundamental mechanisms of pleiotropy through computational modeling. My research focused on understanding how pleiotropic effects shape coevolutionary dynamics, using mammalian dental development as a model system to study these broader evolutionary principles. This work contributed to our understanding of how genetic changes affecting multiple traits simultaneously influence

evolutionary trajectories. I demonstrated advanced programming capabilities by adapting and extending an existing Fortran program to incorporate novel evolutionary algorithms. A key innovation in my work was the development of an automated system for analyzing morphological interactions between developmentally linked structures, which transformed three-dimensional morphological data into two-dimensional representations. This system efficiently identified optimal interaction patterns between coupled developmental structures, representing a significant methodological advancement in the study of pleiotropic effects in evolution. The computational demands of this research required extensive use of the Lyon supercomputing cluster, where I managed large-scale parallel simulations and data analysis workflows. This work combined elements of evolutionary biology, computational geometry, and high-performance computing to address fundamental questions about the role of pleiotropy in development and evolution. Through this research, I enhanced my expertise in complex algorithm development, three-dimensional data analysis, and high-performance computing environments, while contributing to our understanding of how pleiotropic constraints shape evolutionary trajectories.

01.06.2014 - 31.05.2021. Doctoral Researcher under Dr. Isaac Salazar Ciudad at the University of Helsinki, focusing on evolutionary developmental biology through computational modeling. I developed computational methods to investigate the stability mechanisms in complex organism development and evolution. My research centered on EmbryoMaker, an advanced 3D computational model that simulates biomechanical interactions and cellular behaviors in animal tissues. I demonstrated strong programming expertise through developing and implementing scientific algorithms primarily in Fortran, while utilizing Bash for automation and workflow management. My technical proficiency extends to high-performance computing, where I leveraged the CSC TAITO supercomputing cluster using SLURM for efficient job scheduling and resource optimization. I further enhanced computational performance by implementing CUDA parallelization in Fortran-based simulations. For data analysis and visualization, I employed Python and R to process and interpret large-scale simulation outputs. My research findings have been disseminated through peer-reviewed publications and presentations at international conferences and seminars, demonstrating my ability to communicate complex scientific concepts to diverse audiences.

Research funding and grants

18.07.2018 - 18.07.2019. Grand Challenge Application, grant provided by the CSC in Finland to provide computational resources. Amount granted: 7,000,000 Cpuh. I initiated the process to apply for this grant, wrote the initial draft of the application and helped to revise it. Principal investigator was Isaac Salazar Ciudad.

15.07.2016 - 18.08.2017. Grand Challenge Application, grant provided by the CSC in Finland to provide computational resources. Amount granted: 6,000,000 Cpuh. I initiated the process to apply for this grant, wrote the initial draft of the application and helped to revise it. Principal investigator was Isaac Salazar Ciudad.

Research output

Publications

Hagolani PF, Zimm R, Marín-Riera M and Salazar-Ciudad I. "Cell signaling stabilizes morphogenesis against noise." Development 146.20 (2019): dev179309. Peer-reviewed scientific article.

Hagolani PF, Zimm R, Vroomans R and Salazar-Ciudad I. “On the evolution and development of morphological complexity: a view from gene networks.” PLoS Comput Biol 17 (2021): e1008570. Peer-reviewed scientific article.

Dingle K, **Hagolani PF**, Zimm R, Umar M, O'Sullivan S, Louis A. “Bounding phenotype transition probabilities via conditional complexity.” biorxiv. https://doi.org/10.1101/2024.12.18.629197

Hagolani PF, Sémon M, Beslon G, Pantalacci S. “Pleiotropy accelerates tooth phenotypic and genomic evolution — An in silico study under the lens of development”. biorxiv. https://doi.org/10.1101/2025.04.11.648404

PhD Thesis

Title: On the origins and evolution of morphological complexity : a developmental perspective

Defense date: 10.06.2021

Link: https://helda.helsinki.fi/items/70fabb91-bb27-4dc5-8635-458c1ec1a3ed

Teaching merits

- Pedagogical training
  - 2019. UP2 Constructive alignment in Course Design. University of Helsinki.
  - 2017. UP1 Teaching and learning in higher education. University of Helsinki.
- Teaching
  - 2018. Evo-Devo: The whole story. University of Helsinki. Function: Teacher and designer of the course.
  - 2014. Teaching assistant in the Universitat Autònoma de Barcelona.

References

- Sophie Pantalacci. Previous employer. Email: sophie.pantalacci@ens-lyon.fr
- Kamaludin Dingle. Previous employer. Email: dingle.k@gust.edu.kw