CURRICULUM VITAE

JESÚS FERNÁNDEZ SÁNCHEZ

1. Name, birth date and place: Jesús Fernández Sánchez, born on May 12, 1976 in Barcelona.

Current position. Institution, speciality and year of the Ph.D. degree: Associate professor of the Department of Mathematics, Univestiat Politècnica de Catalunya. My line of research is mainly Phylogenetic Algebraic Geometry. The year of my PhD degree (on Singularity theory) was 2005.

2. Research statement.

- *Design of new method for phylogenetic reconstruction based on algebraic and semi-algebraic conditions of the models.* Tools and results from algebraic geometry and commutative algebra can be of great help to formulate new methods to reconstruct evolutionary relationships between populations, living species or genes. This is a transversal line of research which has attracted lot of attention in the recent years.
- *Study of mathematical properties of evolutionary models used in phylogenetics.* Most of phylogenetic studies are based on evolutionary models which are formulated in terms of (hidden) Markov chains. However, some of these models are not biologically realistic or they are not completely consistent with the statistical inference of parameters.

3. Academic trajectory with special emphasis on the research in the last 6 years

In February 2005, I defended my doctoral dissertation on singularity theory (algebraic geometry) under the direction of Eduard Casas-Alvero, which was unanimously awarded with excellent cum laude. Since January 2006, I have been carrying out my research work in the UPC, initially with a research contract "Juan de la Cierva" and, later, as a lecturer and associate professor. As a member of the new research group, I forked the research work in two different lines. The first one dealt with the existence of birational projections of surface singularities and the study of integrally closed ideals in two dimensions (collaboration with Maria Alberich-Carramiñana); the second one was a more applied line of research, known as phylogenetic algebraic geometry, where different areas of mathematics (mainly algebraic geometry, commutative algebra, Lie group theory, probability and statistics) converge in a problem of biological motivation (main collaboration with Marta Casanellas). In 2010 I did a research stay at the School of Mathematics and Physics at the University of Tasmania (Australia) to collaborate with the theoretical physics team (led by Peter Jarvis) to study new evolutionary models with a solid foundation. For this stay, I obtained a special grant from the "UTAS Visiting Fellows and Visiting Scholars" and another from the teacher mobility program of UPC. In the last years, my research has been mainly focused in the following three main lines:

- Design of new methods for phylogenetic reconstruction (collaboration with Marta Casanellas).
- Study and design new evolutionary models with good mathematical properties so that the statistical inference of parameters of the model is consistent (main collaboration with Jeremy Sumner and Peter Jarvis, but also Michael Woodhams, Michael Charleston and Barbara Holland);
- Study of algebraic varieties (degree, equations and singularities) related to phylogenetic models from the perspective of algebraic geometry (collaboration with Marta Casanellas and Mateus Michalek).

In these three lines, we have been able to publish in top impact journals (Q1) in the areas of Mathematics and Evolutionary Biology.

As an organizer of scientific events, I organized the international month program "Algebraic and Combinatorial Phylogenetics" (2017) in the BGSMath monthly program (https://bgsmath.cat/event/algebraic-and-combinatorial-phylogenetics-2/). This meeting included three main courses by top researchers in their field (Mike Steel, Arnd von Haeseler and Piotr Zwernik) together with contributed talks. It also included a 1 week international workshop on the topic (https://bgsmath.cat/event/algebraic-and-combinatorial-phylogenetics-3/). I have also been part of the

local committee of several international conferences, as MEGA 09 and FoCM 2017, the conference EACA 2014 and been responsible for the local seminar on Algebraic geometry UB-UPC (2008/09). I've been invited to give talks on my research in several conferences, workshops and seminars.

4. At most 5 selected publications within the period 2015-2020.

- A New Hierarchy of Phylogenetic Models Consistent with Heterogeneous Substitution Rates, Systematic Biology 0(0):1-13 (2015) (joint work with Michael Woodhams and Jeremy Sumner)
- Invariant versus classical approach when evolution is heterogeneous across sites and lineages, Systematic Biology (2016), 65 (2), 280-291 (joint work with Marta Casanellas)
- Local equations for equivariant evolutionary models, Advances in Mathematics (2017) , 315, 285-323 (joint work with Marta Casanellas and Mateusz Michalek)
- Embeddability of Kimura 3ST Markov matrices (2018), Journal of Theoretical Biology, Volume 445, 128-135 (joint work with Jordi Roca-Lacostena)
- Distance to the stochastic part of phylogenetic varieties, Journal of Symbolic Computation 104, 563-682 (joint work with Marta Casanellas and Marina Garrote-López)

6. Supervision of master and Ph.D. students (indicating current academic or professional position), postd oc mentoring.

Supervisor of the Ph D thesis (both to be defended in 2021)

- Marina Garrote-López, Algebraic and Semialgebraic tools for phylogenetic reconstruction
- Jordi Roca Lacostena, The Embedding problem for DNA Markov matrices

I've also supervised of 6 master projects (TFM's) of the Master of Applied Mathematics and Mathematical engineering of the Universitat Politècnica de Catalunya.

7. Main funded research projects (indicating granting agency, role in the project and budget).

- Geometría, Álgebra, Topología y Aplicaciones mutidisciplinars PID2019-103849GB-I00, Ministerio de Ciencia y Educación, 160.809,00 euros, 2020-23, Researcher
- Geometría y topología de variedades, álgebra y Aplicaciones MTM2015-69135-P, Ministerio de Economía y Competitividad, 150.600 euros, 2016-20, Researcher
- Geometria de Varietats i Aplicacions 2017 SGR 932, AGAUR. Agència de Gestió d'Ajuts Universitaris i de Recerca, 65.896,00 euros, 2017-19, Researcher

8. Other merits

Main responsible of the subjects "Linear Algebra" and "Taller de Matemàtiques" of the Industrial Engineering degree, "Algebraic Geometry" of the Maths degree and "Mathematical models in Biology" of the Master on Advanced Mathematics and Mathematical Engineering of the Universitat Politècnica de Catalunya.

Supervisor of several Degree Projects of the Mathematics degree (TFG). I've been part of several evaluation boards of master thesis (TFM) and PhD thesis.