

Discrete Dynamical Systems

The project of the research group Dynamical Systems
CIMA - University of Évora



First Joint Meeting Évora-Extremadura on Mathematics

University of Extremadura, Badajoz, 14 January, 2016

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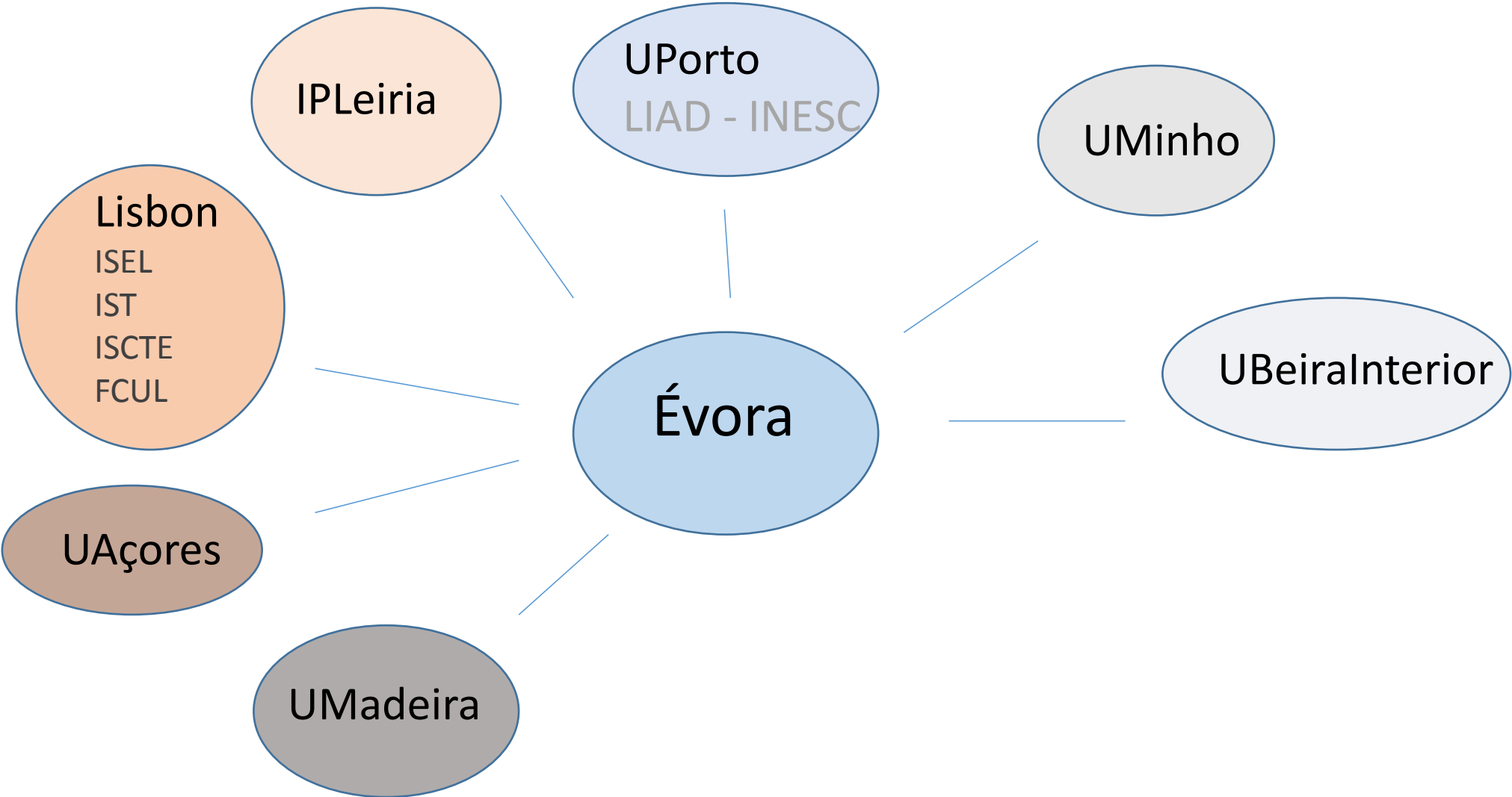
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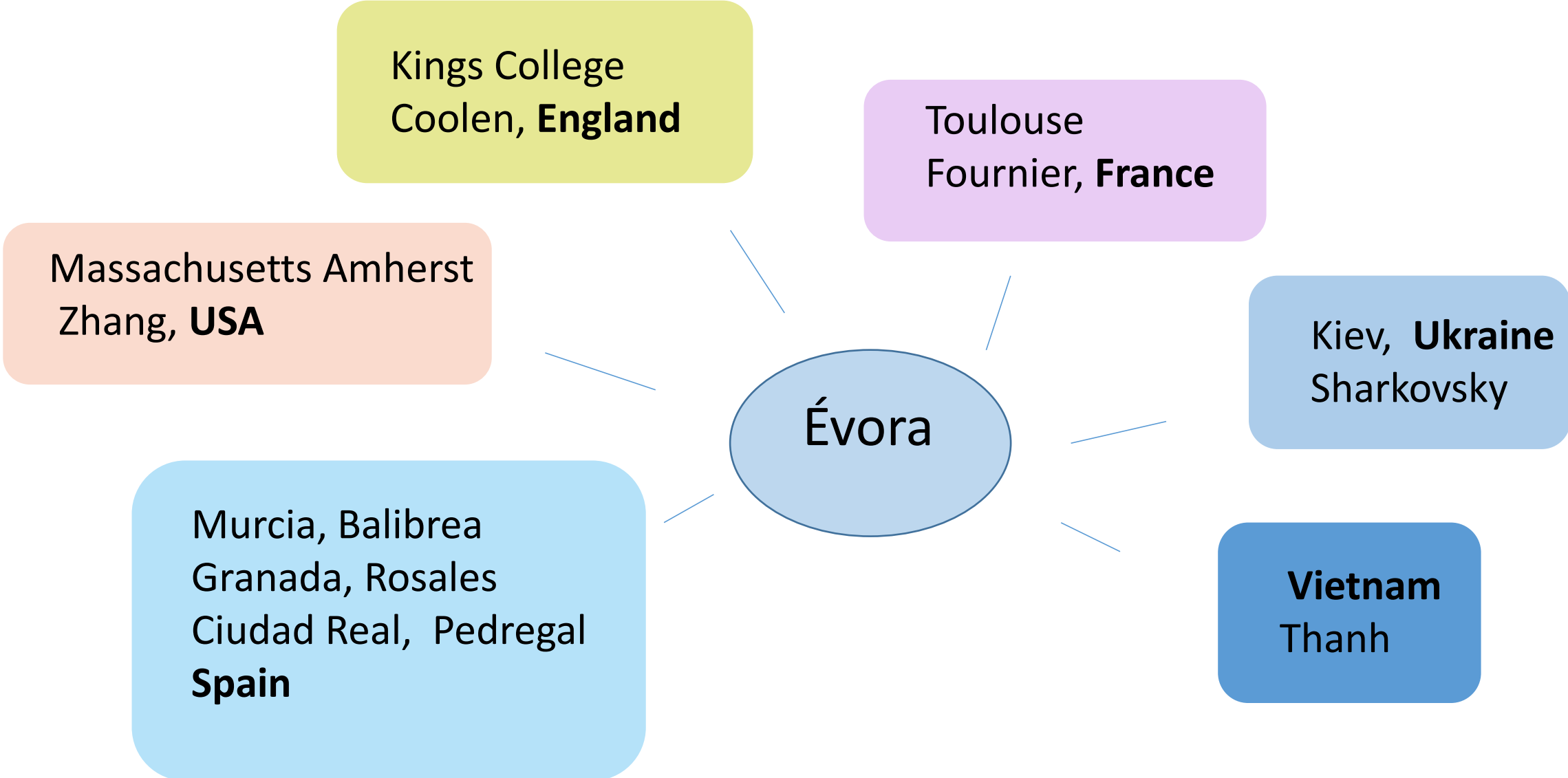
Marília Pires

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Scientific relations: Portugal



Scientific relations: *International*



Major tendencies in contemporary Mathematics

which we take into account – guiding lines

Progressive algebrization, abstraction of the objects, the structures and focus on the relations. The relevant aspects become the properties of the relations and the new structures arising from its formalization.

Major tendencies in contemporary Mathematics

which we take into account – guiding lines

Dynamical systems as a subject which contaminates all the mathematical areas, focusing on the change of structures under deformation or under time flow. Classification of the typical transient and the typical asymptotic.

Major tendencies in contemporary Mathematics

which we take into account – guiding lines

Complexity, or how to describe and to deal, developing adequate formalisms, with gigantic structures with a enormous number of non negligible parts.

Major tendencies in contemporary Mathematics

which we take into account – guiding lines

The previous three points correspond, **not to well defined disciplines** in mathematics nowadays, but to **general tendencies** which in our opinion will be some of the most relevant.

Main subjects within dynamical systems

group project 2015-2020

1. Discrete dynamical systems DDS
2. Dynamics on Networks.
3. Evolutionary dynamics
4. Reduction of continuous systems to DDS
5. Information processing and chaos control
6. Hyperbolic geometry
7. Combinatorics and number theory

Main subjects within dynamical systems

group project 2015-2020

Selected details

1. Discrete dynamical systems: Interval maps. Topological classification. Renormalization and star products. Symbolic Dynamics.
2. Dynamics on Networks.
3. Evolutionary dynamics
4. Reduction of continuous systems to DDS
5. Information processing and chaos control
6. Hyperbolic geometry
7. Combinatorics and number theory

Main subjects within dynamical systems

group project 2015-2020

Selected details

2. Dynamics on Networks.

3. Evolutionary dynamics

4. Reduction of continuous systems to DDS

5. Information processing and chaos control: Dynamical systems designed to be considered as abstract (analogical) computers through symbolic dynamics, and the study of networks of coupled DDS

6. Hyperbolic geometry

7. Combinatorics and number theory

Main subjects within dynamical systems

group project 2015-2020

Selected details

2. Dynamics on Networks.

3. Evolutionary dynamics

4. Reduction of continuous systems to DDS

5. Information processing and chaos control

6. Hyperbolic geometry: Kleinian groups. Biliards. Geodesic flow. Relations with number theory and operator algebras, through trace maps. General symmetries in complex networks.

7. Combinatorics and number theory

Main subjects within dynamical systems

group project 2015-2020

Selected details

3. Evolutionary dynamics

4. Reduction of continuous systems to DDS

5. Information processing and chaos control

6. Hyperbolic geometry

7. Combinatorics and number theory: **Knots and braids**. The introduction of **matroids in the DDS study**. **Tutte polynomials**. **Generating functions and zeta functions for DDS**. **Methods for the arithmetic of very large numbers**. **Discrete optimization**.

Main subjects within dynamical systems

Applications

Laboratory of Complexity 2015-2020

1. Simple systems with complex behaviour
2. Ideal complex systems
3. Computational systems, information and automation
4. Real complex systems
5. Complex systems and art
6. Outreach activities

Physics

Chemistry

Biology

Ecology

Robotics

Economy

...

+ Selected papers 2015 2016

Convergence time to equilibrium distributions of autonomous and periodic non-autonomous graphs. [Linear Algebra Appl 488](#)

Silva, Teresa M.; Silva, Luís; Fernandes, Sara

Stability and ergodicity of moon billiards, [Chaos 25](#)

Maria F. Correia, Hong-Kun Zhang

Nonautonomous graphs and topological entropy of nonautonomous Lorenz systems.
[Internat. J. Bifur. Chaos Appl. Sci. Engrg. 25](#)

Alves, João Ferreira; Silva, Luís

Spectral invariants of periodic nonautonomous discrete dynamical systems
[J. Math. Anal. Appl. 430](#)

Alves, João Ferreira; Málek, Michal; Silva, Luís

+ Selected papers 2015

Complete synchronization and delayed synchronization in couplings. [*Nonlinear Dynam.* 79](#)

Luís Lopes; Sara Fernandes; Clara Grácio

Partial classification of Lorenz knots: syllable permutations of torus knots words. [*Phys. D* 306](#)

Nuno Franco, Luis Silva; Paulo Gomes

Syllable permutations and hyperbolic Lorenz knots. [*Appl. Math. Inf. Sci.* 9](#)

Paulo Gomes, Nuno Franco, Luis Silva;

+ Selected papers 2015

On the spectra of certain matrices and the iteration of quadratic maps. [Se[→] MA J. 67](#)

Bandeira, Luís; Correia Ramos, Carlos

Systoles on compact Riemann surfaces with symbolic dynamics, [Springer Proc. Math. Stat.](#), 112

Clara Grácio

Self similarity of Sousa Ramos's trees and Mira's boxes within the boxes. [Appl. Math. Inf. Sci. 9](#)

Baptista, D, Fournier-Prunaret, D, Grácio, C; Fernandes ,S.

PhD Theses Concluded - last 5 years

- **Luis Lopes (2015) *Acoplamentos de Sistemas Dinâmicos Caóticos*, UÉvora, ISEL**
- **Teresa Silva (2015) *Invariants of Nonautonomous Discrete Dynamical Systems*, UÉvora, ISEL**
- **Pedro Simões (2015) *Knots and Links in Templates with Several Branch Nodes*, UÉvora, ISEL**
- **Catia Dias (2013) *Lattices related to Conway's construction*, UÉvora, Dalhousie University**
- **Fátima Correia (2012) *Infinite dimensional dynamical systems associated to interval maps*, UÉvora**
- **Alexandra Baptista (2012) *Discrete Dynamical Systems in Algebras*, UÉvora, IST**
- **Mário Getimane (2011) *On Random Matrices and its Applications*, UMinho, UÉvora**
- **Cristina Januário (2010) *Sistemas Dinâmicos Discretos em Baixa Dimensão* UÉvora, ISCTE**
- **Acilina Caneco (2010) *Sincronização caótica de sistemas não-lineares* UÉvora, ISEL**
- **Diogo Baptista (2009) *Iteradas de aplicações do plano no plano* UÉvora, UMinho**

PhD Theses On going

- Paulo Gomes, *Application of Symbolic Dynamics to the Classification of Lorenz-like Knots*, Uévora, ISEL
- Carla Morbey, *Dynamical systems applied to biology*, Uévora, ISEL
- Susana Santos, *Numerical semigroups and Iterated maps of the interval*, Uévora