



# SEMINAR

# Are almost all trapped trajectories fully experiencing a chaotic attractor?

Prof Fabio Dercole (Politecnico di Milano, Italy)

Friday, 16 August 2024 @ 14h00-15h00 SAST

**Venues:** Online and Physics Seminar Room, Stellenbosch University

## ABSTRACT

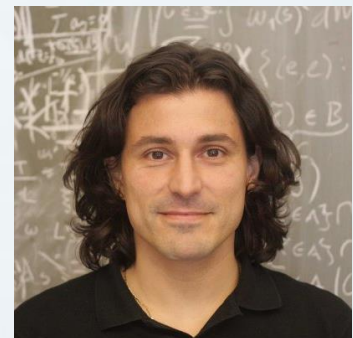
Chaos is the most complex dynamic behaviour a system can show. Yet, it is produced by two simple, though one nonlinear, deterministic mechanisms, hence the more proper name "Deterministic Chaos". The first mechanism, "stretching", acts locally and linearly, expanding small sets in the system's state space in (at least) one direction and contracting in the others. The second mechanism, "folding", acts globally and is the nonlinear operation of bending the elongated sets to form the forward image of the original sets. These two simple operations are invertible and produce a "chaotic set" for the system's forward and backward map, containing an uncountable infinity of astonishingly complex system's trajectories. The most effective, yet simple, explanation of chaos I ever heard is James A. Yorke "pizza machine" (plenary lecture at the SIAM DS, Snowbird, 2003): kneading the pizza dough is nothing but stretching and folding. The mathematical formalisation is Stephen Smale's horseshoe map. Using this nice tool, I revisit the hallmarks of chaos, one of which (in the title) is still missing a constructive proof.

## BIOGRAPHY

Fabio Dercole is Associate Professor of Systems and Control Theory at the Department of Electronics, Information, and Bioengineering at Politecnico di Milano, Italy. He received his MSc and PhD degrees in Information Technology from Politecnico di Milano in 1999 and 2003 respectively.

His research interests are within the broad area of complex systems, with particular focus on nonlinear dynamics, networks of interconnected systems, agent-based systems and, more recently, on projects of Citizen Science. He is the author of several scientific papers and has been a visiting scientist in several institutes.

He was awarded the 2003 Chorafas Prize for his PhD dissertation on evolutionary dynamics, and the 2008 Ricercatissimi Prize for his book *Analysis of Evolutionary Processes*. From 2010 to 2015, Fabio has been PI of a 5-year research grant with the project 'Modeling and Analysis of Innovation and Competition Processes'. In 2021 he was elected President of the Italian Society for Chaos and Complexity.



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