e-Flux is a visionary project that brings evolvability concepts to Information Technology, providing radically new knowledge and theoretical foundation to widen IT impact on our society and quality of life.

This project rests on the realization that forefront theoretical research, coupled to cutting-edge technologies, can produce the necessary knowledge and know-how to understand how complex system evolve. In particular, it will show how the study of evolvability in natural systems can be applied to technological purposes.

Thanks to the realisation of digitally controlled microfluidic systems, the team will study compartment and cell populations with an unprecedentedly large number of individuals. This will enable us to develop an evolution machine to monitor evolutionary paths of large populations for long periods of time.

Understanding evolvability could bring a step forward towards the comprehension of the fluid automata, with impact on drug discovery and biotechnology. Technological and theoretical sources amalgamate into a bottom-up research project.

Project Cordinator

Parmenides Foundation
Kardinal-Faulhaber-Straße 14a
D - 80333 München, Germany
Phone: +49 (0) 89 255 408 96
Fax: +49 (0) 89 255 408 79
Email: contact@parmenides-foundation.org
www.parmenides-foundation.org

Prof. Dr. Eörs Szathmáry

Project Partners

Université Pierre et Marie Curie, Paris VI
Prof. Jérôme Bibette
Ecole Supérieure de Physique et Chimie Industrielle
Laboratoire Colloïdes et Matériaux Divisés

Université Louis Pasteur
Prof. Andrew Griffiths
Laboratoire de Biologie Chimique – Institut de Science et d'Ingenierie Supramoleculaires (ISIS)

University of Sussex
Prof. Phil Husbands
Dept. Informatics
University of Sussex

Universitat Autònoma de Barcelona
Prof. Mauro Santos
Departament de Genètica i de Microbiologia
Facultat de Biociències

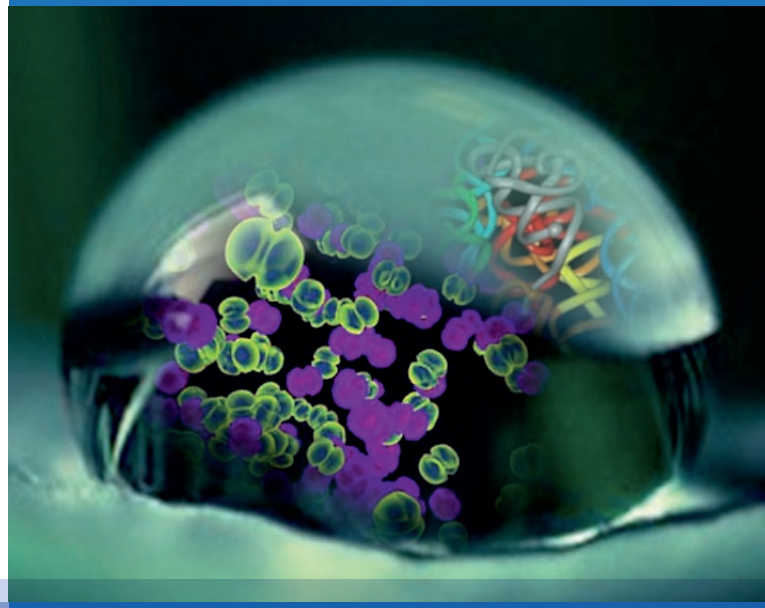
Wageningen University
Dr. Arjan de Visser
Laboratory of Genetics

University of Thessaly
Dr. Elias Zintzaras
Department of Biomathematics

This project Is being funded by EU Commision DG Research within the VII Framework Program for Research and Development

e-Flux

Evolutionary Microfluidix e-Flux



This project is being funded by EU Commision DG Research within the VII Framework Program for Research and Development

What is the connection between evolution and information technology?

Ever since the insightful work of John von Neumann, self-reproducing automata are considered to be a main long-term goal of Information Technology.

A corollary to this goal is to understand how complex systems can be robust and evolvable. Biologists deal with complex systems that arose in the course of evolution by natural selection.

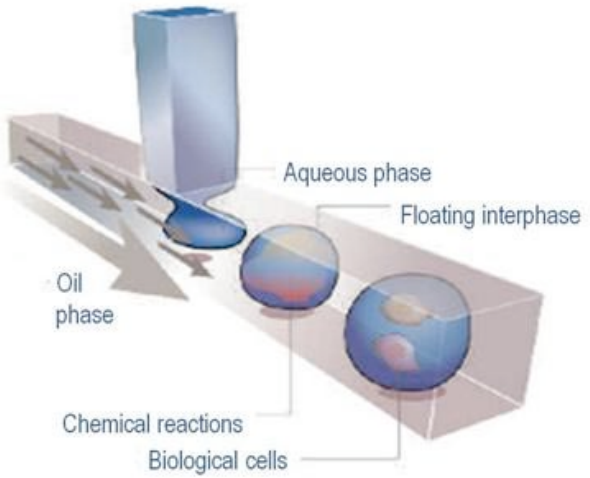
The future realization of technological artefacts that will mimic, or be inspired by biological automata, will face many problems that biological evolution had to solve.

Biological systems are robust to internal and external perturbations, nevertheless they are evolvable.

What makes complex systems evolvable?

In order to tackle this question, the e-Flux project studies evolvability principles in a particular class of systems – fluid automata.

By doing so, we hope to develop techniques that help computer scientists harnessing the principle of evolvability in natural systems for engineering purposes.



e-Flux will develop droplet-based digital microfluidic systems for the manipulation of reproducing artificial compartments and natural cells (including the analysis of adaptive pathways and molecular cooperation).

e-Flux will distil insights from the comparative investigation of results on cooperation, adaptation, robustness and evolvability that could be utilized by future biomimetic and biology-inspired, reproducible and mutable fluid automata, and analyze the non-symbolic computations and the evolving representations from the perspective of selfreproducing automata.

The e-Flux team will produce and test designs for implementations of associative learning networks in various biochemical systems and synthesise a version of the network.

The team will build an evolution machine by the development of a (semi-)automated serial-transfer protocol using micro- or mini-fluidics, which will be able to automatically cycle a population of few hundred thousand individual molecules or cells, evolving in parallel over a long time period.

This device allows the detailed monitoring of unique and repeatable evolutionary pathways taken by populations consisting of a very large number of individuals.

This instrument will be a new and powerful tool for drug discovery and for biotechnology.

Evolutionary Microfluidix e-Flux