Project factsheet

CORENET

Complex chemical reaction networks for breakthrough scalable reservoir computing

Background

The underlying idea of CORENET is to harness the potential of complex reaction networks (CRNs) to create a chemical reservoir computing system in which molecules are generated as a result of high-level computations performed by molecular ensembles left to freely react within a microfluidic device. The implementation of material computing using chemical reactions has long been postulated but never realised, mostly because the underlying chemistry needs to be executed in the most reproducible manner, which can only be achieved with the best-performing reactor hardware.

The main goal of CORENET is to harness the potential of complex reaction networks to create powerful chemical reservoir computing systems. This molecule-based computing power enables truly sustainable AI, which speaks the language of living systems and can constantly process information about their molecular environment.

In such a way, CORENET will lay the foundations for a new era in the chemical sciences with scalable and energy-efficient systems that can directly interface with living organisms.

Objectives

The primary aim of the CORENET consortium is to construct brain-mimicking computing devices that utilise networks of chemical reactions as molecular information processing systems.

Among the objectives, the multidisciplinary team identified 3 interrelated scientific and technological objectives:

- to explore reaction patterns (e.g., feedback loops and autocatalytic subsets/ cycles) in complex reaction networks and establish parallels with the mechanisms of metabolic regulation, thermal homeostasis and biological oscillations
- to integrate the recurrent reaction networks developed previously into a microfluidic flow system that provides full control over input variables and interfaces with analytical equipment to measure the output of such networks and further develop suitable interfaces with Gas chromatography and Liquid chromatography–mass spectrometry analytical methods
- to deploy the CRNs developed together with their automated on-chip operation and product analytics for computing purposes

Project duration

01.04.2022 – 31.03.2026

Project budget

3 million euro

Project website

www.corenet-horizon.eu

European Innovation Council

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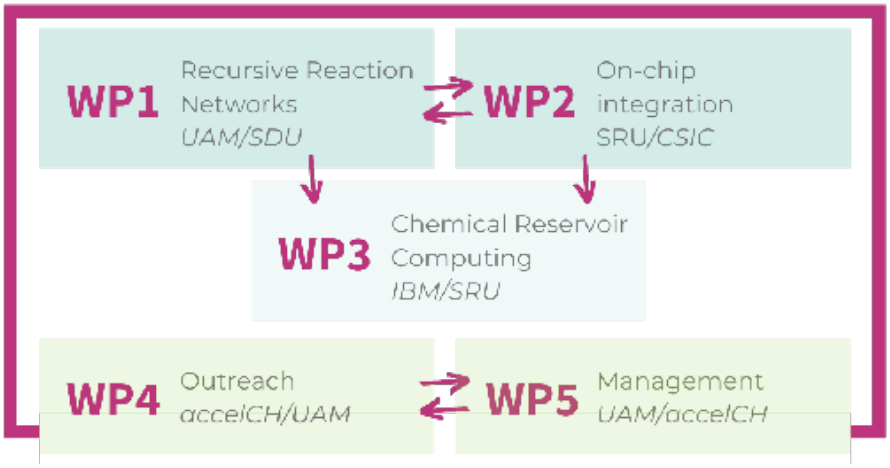
Activities

The activities in the CORENET project are divided into specific work packages (WPs). First three WPs focus on the scientific part of the project and contain the following:

- WP1 lays the foundation of the CRNs
- WP2 enables the on-chip integration of the CRNs.
- Their initial results will be required for WP3 to develop an RC system.

The two non-scientific WPs, WP4 and WP5, will run in parallel from the whole project's duration and

Impact



The impact of the CORENET project reaches far and beyond the specific research areas of its consortium. In the long-term vision, the research findings are expected to have potential impact covering all the main key impact pathways highlighted by the EC, including scientific, societal, as well as economic/technological impact.

Scientific impact

- New knowledge bridging systems chemistry, microfluidics technology and computer science

Societal impact

- Personalised patient treatment via in situ synthesis of drug molecules
- Cheaper drug discovery and patient treatment

Economic/ Technological impact

- Chemical reservoir computing devices that work at net-zero computational power, enabling truly sustainable and green AI

Project Coordinator

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Project Participants

- Universidad Autónoma de Madrid (UAM)
- Radboud Universiteit (SRU)
- Consejo Superior de Investigaciones Científicas (CSIC)
- Syddansk Universitet (SDU)
- IBM Research Europe – Zurich (IBM)
- accelopment Schweiz AG (accelCH)

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