ISTITUTO ITALIANO DI TECNOLOGIA

UWE Bristol University of the West of England

COgITOR

OPENAZIENDA

Colloidal Reservoirs: Liquid Artificial Intelligence for Scalable, Robust, and Physics-Inspired Computation

A. Chiolerio*, M. Crepaldi, R. Fortulan, N.R. Kheirabadi, P. Pilia, A. Adamatzky

EuCAIFCon 2025

Cagliari 17th June 2025

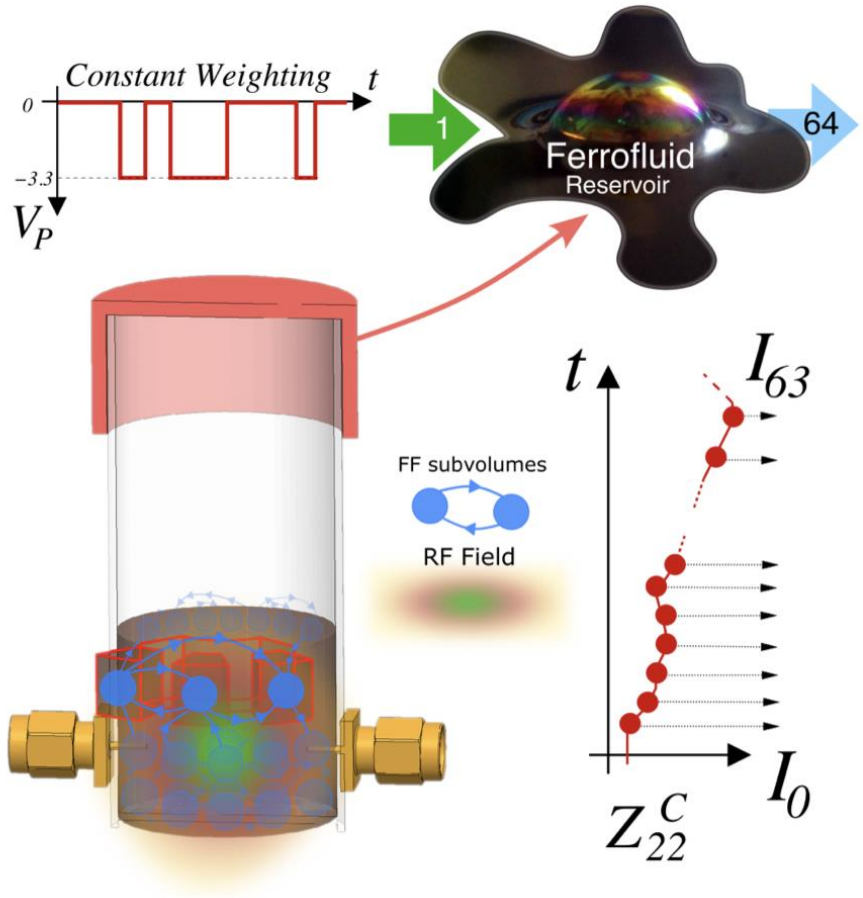
EUROPEAN AI FOR FUNDAMENTAL PHYSICS CONFERENCE
EuCAIFCon 2025

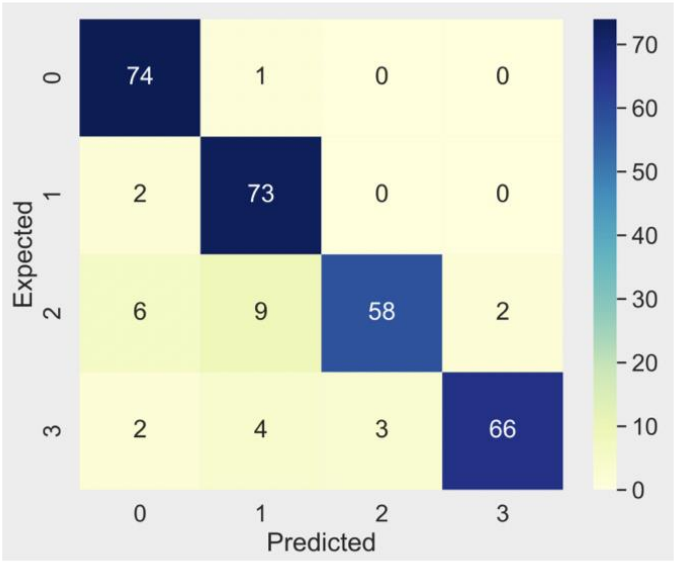
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 964388

Reservoir Computing

Reservoir computing (RC) has emerged as a powerful paradigm for **processing temporal data and pattern recognition**, leveraging the intrinsic dynamics of complex systems to perform high-dimensional nonlinear transformations.

Our recent achievements show that **colloidal systems — specifically engineered suspensions of nanoparticles in fluids — offer a promising physical substrate for RC**, combining the adaptability and resilience of soft matter with the functional requirements of neuromorphic computing.



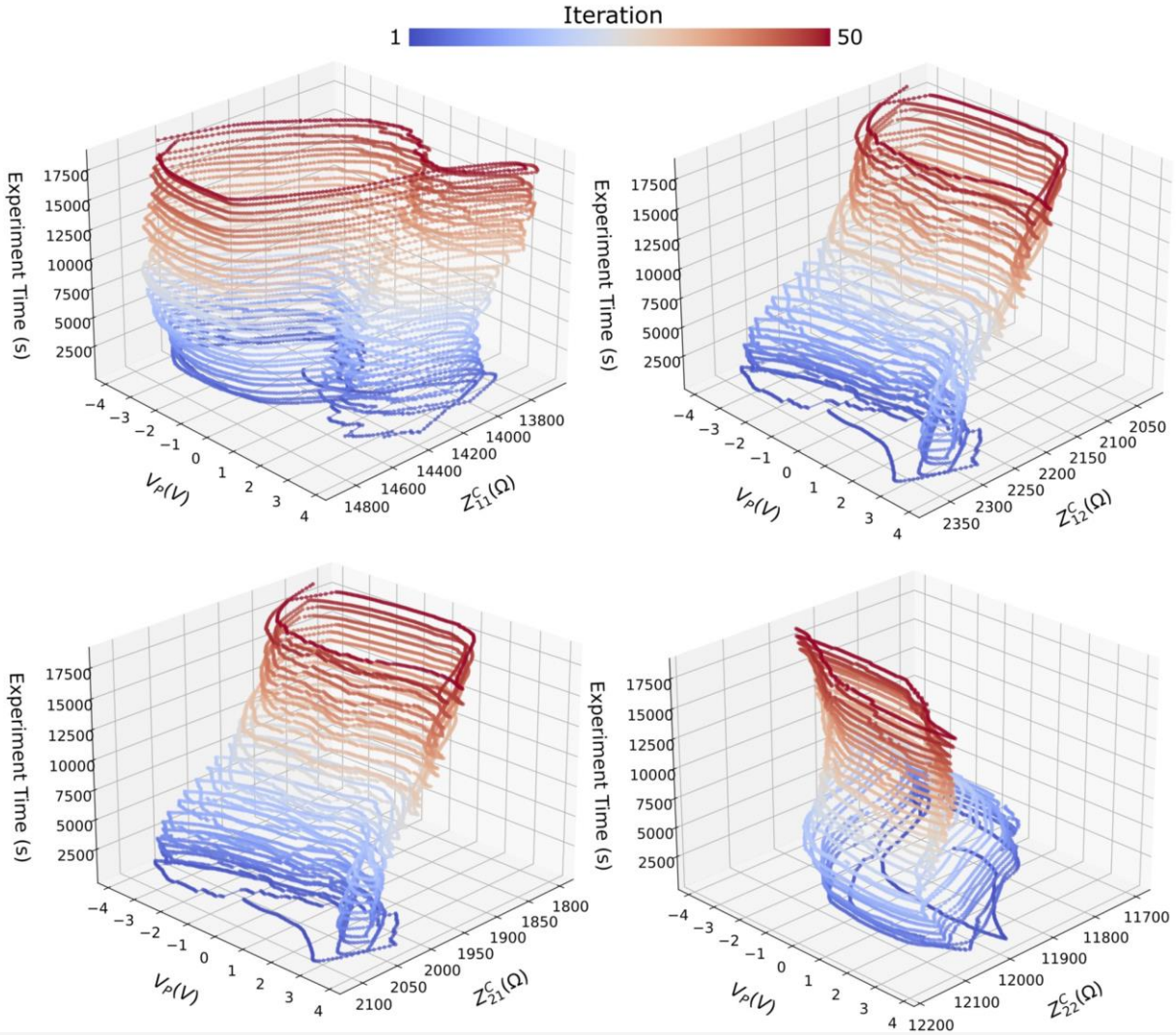


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 964388

The Scattering Parameters

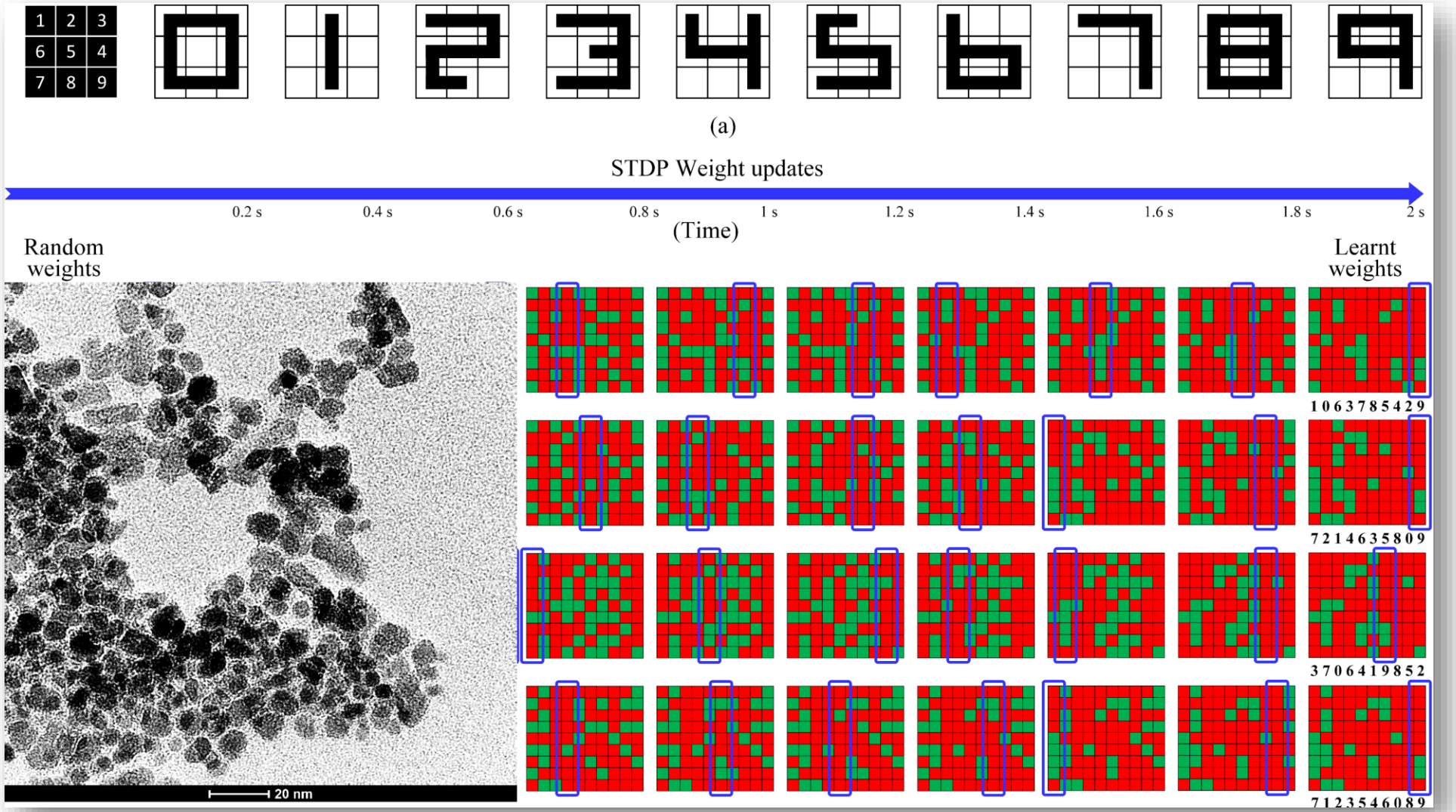
$$\begin{bmatrix} V_1^- \\ V_2^- \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} V_1^+ \\ V_2^+ \end{bmatrix}$$

$$Z_{ij}^C = \int_{\omega_{min}}^{\omega_{Max}} |Z(\omega)_{ij}| d\omega = Z^M(\omega_{Max} - \omega_{min})$$



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 964388

Testing with a 4x4 cross-bar array ANN



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 964388

Thank you!

CAGLIARI

17TH JUNE 2025

OPENAZIENDA

EUROPEAN AI FOR FUNDAMENTAL PHYSICS CONFERENCE
EuCAIFCon 2025

UWE Bristol | University of the West of England

alessandro.chiolerio@iit.it
www.cogitor-project.eu

ISTITUTO ITALIANO DI TECNOLOGIA