CORTEX

CORE MONITORING TECHNIQUES AND EXPERIMENTAL VALIDATION AND DEMONSTRATION

Launched in 2017, the European Horizon 2020 CORTEX project aims to **develop innovative core monitoring techniques that allow to detect anomalies in nuclear reactors while operating.** Because of the early detection of operational problems, the utilities will be able to take proper actions before such problems have any adverse effect on plant safety and reliability.

★ 20 ★ PARTNERS

48 MONTHS

11 COUNTRIES

8 TRAINING COURSES

THE PROPOSED TECHNIQUES ARE BASED ON USING THE INHERENT FLUCTUATIONS IN NEUTRON FLUX (NEUTRON NOISE) RECORDED BY THE IN-CORE AND EX-CORE INSTRUMENTATION.

OUTPUTS

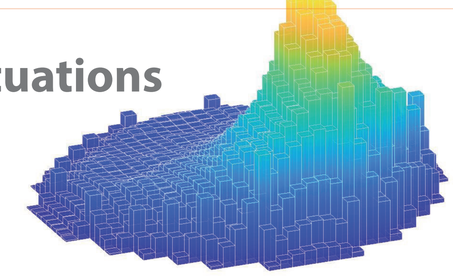
Contribute to:

- The early detection of anomalies in operating reactors
- Improved reactor safety and higher plant availability
- Reducing the CO2 footprint and impact to the environment
- A higher availability of cheap base-load electricity to consumers

WORK PROGRAM

WP 1: Developing high fidelity tools for simulating stationary fluctuations

Develop modelling capabilities allowing the determination of the fluctuations in neutron flux (and the associated uncertainties) resulting from known perturbations applied to the system.



Example of simulation in the frequency domain giving the radial distribution of the amplitude of the neutron noise induced by a local perturbation in a commercial reactor

WP 2: Validating the modelling tools against experiments to be performed at research reactors

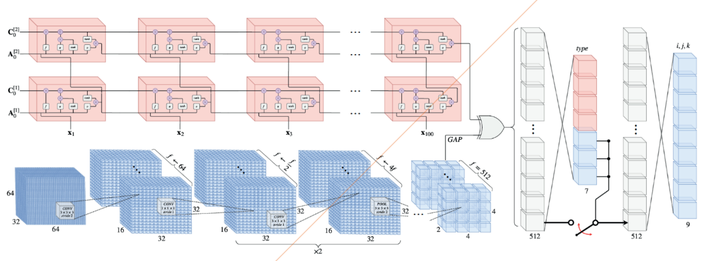
Validate the modelling tools produced in WP1 against dedicated experimental campaigns.

AKR-2 facility at Technische Universitaet Dresden, Germany

COLIBRI experiment in the CROCUS reactor at l'Ecole Polytechnique Fédérale de Lausanne, Switzerland

WP 3: Developing advanced signal processing and machine learning techniques (to be combined with simulation tools)

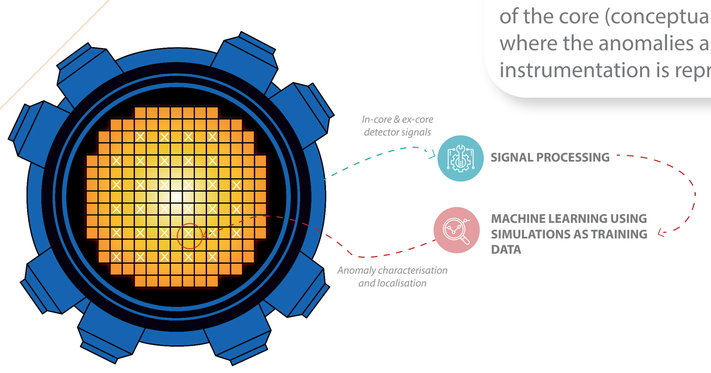
Detect, identify and localise possible anomalies, using signal processing methods and machine learning techniques. The latter use the simulation tools developed in WP1 to provide the necessary training sets.



Developed framework for time and frequency domain perturbation type classification and coordinate regression (Long Short-Term Memory network at the top for time domain signals, and a three-dimensional Convolutional Neural Network at the bottom for frequency domain signals).

WP 4: Demonstrating the proposed methods for both on-line and off-line core diagnostics and monitoring

Demonstrate the applicability and usefulness of the core monitoring technique on commercial reactors.



The project aims at first characterising anomalies and at thereafter identifying regions of the core (conceptually highlighted in red) where the anomalies are located. The in-core instrumentation is represented by the crosses.

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