Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
Università di Pisa

Project FORESEEN

Kickoff meeting

University of Pisa activity and Team

December 18, 2023

FORESEEN

FORMAL METHODS FOR ATTACK DETECTION IN AUTONOMOUS DRIVING SYSTEMS

Unit members

Cinzia Bernardeschi	Associate professor @FoReLab	Primary Investigator
Giuseppe Lettieri	Associate professor @FoReLab	
Alessio Bechini	Associate professor @FoReLab	
Alessio Vecchio	Associate professor @FoReLab	

FoReLab

- FoReLab (Future-Oriented REsearch LABoratory) is a project of the Department of Information Engineering of the University of Pisa, funded by the Italian Ministry of Education under the programme "Dipartimenti di Eccellenza".

- FoReLab develops technologies and methodologies for paving the way to a new generation of industry, autonomous, sustainable, resilient and person-centered.

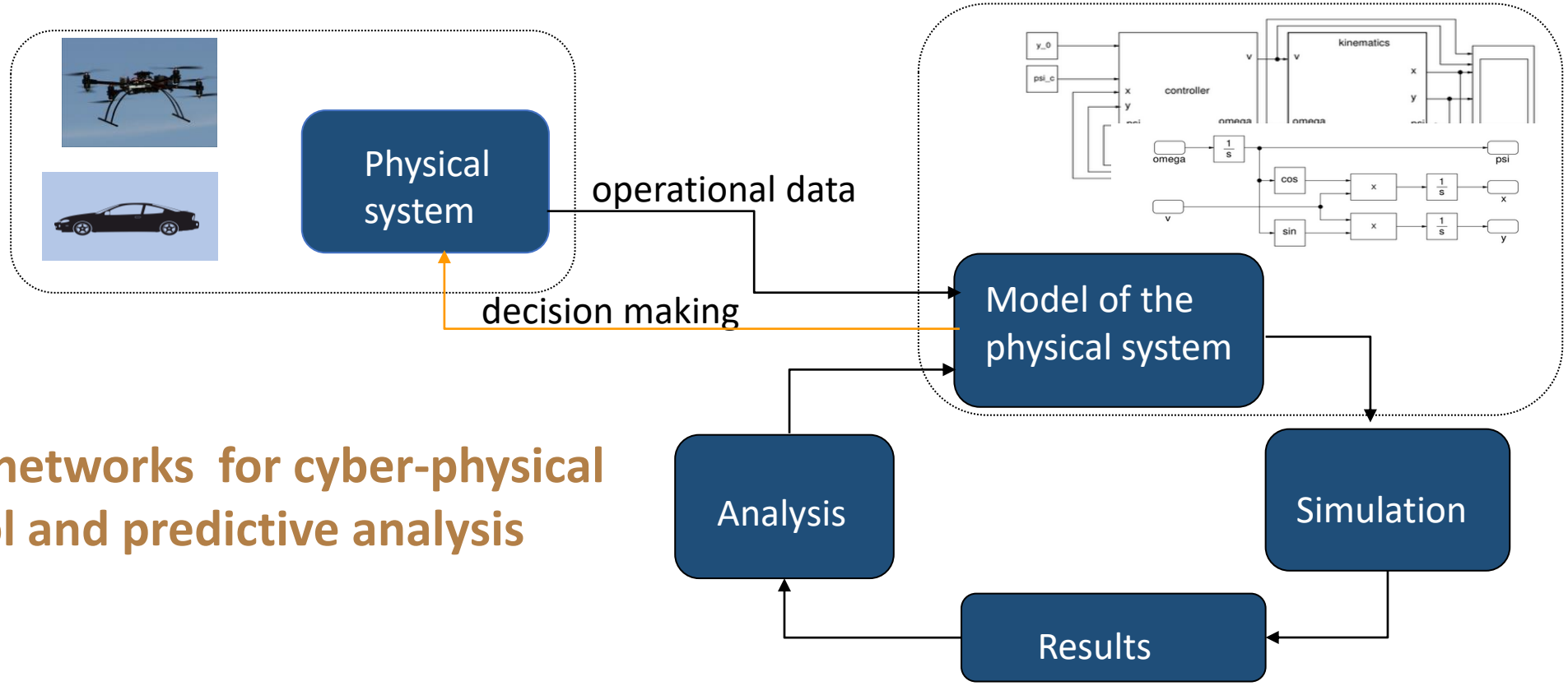
FoReLab

combines research activities, staff and infrastructure through a holistic approach that leverages the contribution of all the ICT disciplines and develops four research lines:

- *Trustworthy Artificial and Embodied Intelligence*, with the objective of making AI and collaborative robotic systems dependable and usable for critical applications;
- *Human-Centric Systems,* to develop ICT systems that combine human strengths and peculiarities with those of machines;
- *Future Networks*, to engineer networks that can support new industrial processes and emerging applications;
- *Smart Materials Devices*, to design new-generation reconfigurable, adaptive and eco-compatible devices

Our activity

- **Cyber-physical systems modelling, simulation, and verification**



- **Robust neural networks for cyber-physical systems control and predictive analysis**

Previous work related to FORESEEN project

In collaboration with: Univ. degli Studi di Milano(*)
Univ. degli Studi di Palermo (^)
Univ. degli Studi del Molise (&)

• Co-simulation and formal verification

- *Co-simulation of a Model Predictive Control System for Automotive Applications. [LNCS 13230, 2022]*
  Contribution: determine if the controller running on the chosen hardware meets the time requirements and response time of the plant
- *Design and validation of cyber-physical systems through co-simulation: theVoronoi Tessellation use case. [IEEEaccess, 2024]* (^)
  Contribution: coupling of co-simulation and design space exploration to support control parameter calibration to optimize energy consumption and convergence time to the target positions of the swarm
- *Co-simulated Digital Twin on the Network Edge: A vehicle platoon. [Computer Communications, 2023] (*,^)*
  Contribution: Co-simulation and design space exploration for analysing the performance for different communication technologies, and road surfaces.

- **Model-based attack injection and behavioural analysis**

  - *Formalization and co-simulation of attacks on cyber-physical systems. [J. Comput. Virol. Hacking Tech., 2020]*
    Contribution: methodology for the formal modeling of security attacks on cyber-physical systems and the analysis of their effects on the system using logic theories

  - *A framework for formal analysis and simulative evaluation of security attacks in wireless sensor networks. [J. Comput. Virol. Hacking Tech., 2021]*
    Contribution: formal verification and network simulation for enabling designers to evaluate the effects of attacks

  - *Identify Potential Attacks from Simulated Log Analysis. [IJCNN 2020, 2020]* (&)
    Contribution: attack injection and co-simulation in automotive network, generation of logs for the analysis by model checking.

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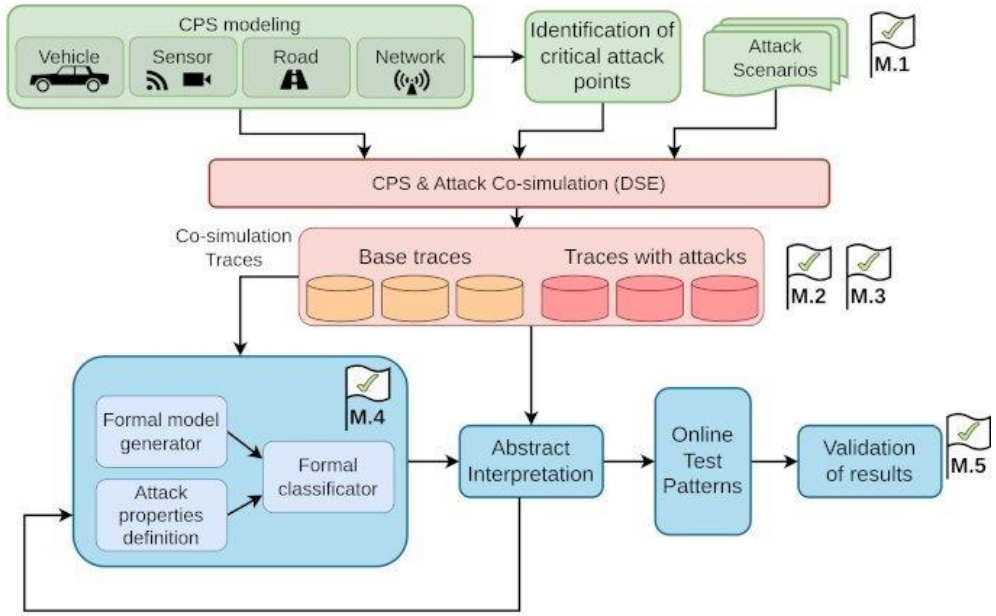
Our main contribution to FORESEEN

- CPS modeling and co-simulation
- Threat analysis and design of attack secnarios
- Model-based attack injection and and trace-data collection
- Abstract interpretation approach for robustness analysis



FORESEEN methodology