



Artificial
Intelligence
and
Intelligent
Systems

 National Lab

HAMU HUB
ABRUZZO
MARCHE
UMERIA



A.D. 1308
unipg

UNIVERSITÀ DEGLI STUDI
DI PERUGIA

INCONTRO DEI NODI LAB CINI AI IN AMBITO H-AMU

*Aula Dessau, Palazzo Murena
Università degli Studi di Perugia - 2 Marzo 2026*

PROGRAMMA

10:00 - 10:15 | Opening

- Prof. Stefano Bistarelli, Direttore Nodo Lab AI&IS, UniPG
- Prof. Carlo Sansone, Direttore Lab Nazionale AI&IS

10:15 - 12:00 | Descrizione delle attività del nodo

- Prof.ssa Francesca Scozzari (UniCH)
- Prof. Nicolas Troquard (GSSI)
- Prof. Primo Zingaretti (UnivPM)
- Prof. Michele Loreti (UniCAM)
- Prof.ssa Stefania Costantini (UnivAQ)
- Prof. Paolo Sernani (UniMC)
- Prof. Stefano Bistarelli (UniPG)

12:00 - 12:15 | Introduzione al Panel Istituzionale H-AMU

- Prof. Stefano Bistarelli, Direttore Nodo Lab AI&IS, UniPG
- Prof. Carlo Sansone, Direttore Lab Nazionale AI&IS

12:15 - 13:25 | Panel: H-AMU come catalizzatore delle collaborazioni dei laboratori CINI AI&IS

- UniPG: Magnifico Rettore Prof. Massimiliano Marianelli
- UniCH: in rappresentanza del Magnifico Rettore Prof. Liborio Stuppia interviene la Prof.ssa Francesca Scozzari
- GSSI: Magnifica Rettrice Prof.ssa Paola Inverardi (videoconferenza)
- UnivPM: in rappresentanza del Magnifico Rettore Prof. Enrico Quagliarini interviene il Prof. Primo Zingaretti
- UniCAM: in rappresentanza del Magnifico Rettore Prof. Graziano Leoni interviene il Prof. Michele Loreti
- UnivAQ: in rappresentanza del Magnifico Rettore Prof. Fabio Graziosi interviene il Prof.ssa Stefania Costantini

13:25 - 14:30 | Lunch

14:30 - 16:45 | Presentazione di alcuni risultati di ricerca del nodo e prospettive di collaborazione con altri nodi

- Prof. Fabio Fioravanti (UniCH)
- Prof. Nicolas Troquard (GSSI)
- Prof. Adriano Mancini (UnivPM)
- Prof. Michele Loreti (UniCAM)
- Prof.ssa Stefania Costantini (UnivAQ)
- Prof. Paolo Sernani (UniMC)
- Dott. Carlo Taticchi (UniPG)

16:45 - 17:00 | Closing



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cini National Lab

Nodo UniPG



CAIRNE Confederation of Laboratories for
Artificial Intelligence Research in Europe

Componenti



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DIPARTIMENTO
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DIPARTIMENTO
DI FISICA E GEOLOGIA

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DIPARTIMENTO DI FILOSOFIA,
SCIENZE SOCIALI, UMANE
E DELLA FORMAZIONE

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DIPARTIMENTO
DI ECONOMIA

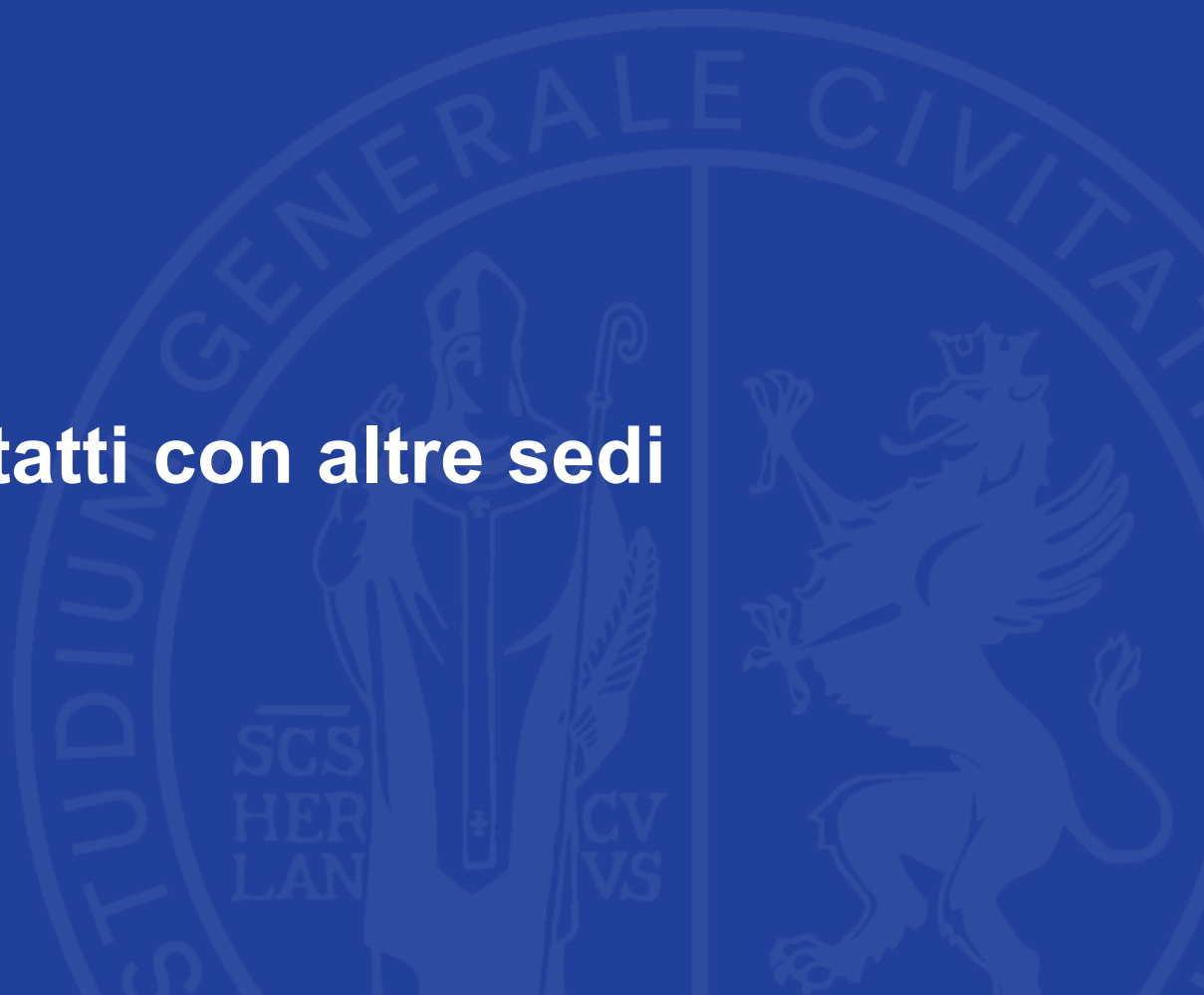
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DIPARTIMENTO
DI INGEGNERIA

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DIPARTIMENTO DI CHIMICA,
BIOLOGIA E BIOTECNOLOGIE

Contatti con altre sedi



Italia

- **Department of Economic Studies, “G. d’Annunzio” University of Chieti-Pescara, Italy**
- Department of Mathematics and Computer Science, University of Udine, Italy
- Department of Computer Science and Engineering, University of Bologna, Italy
- Department of Computer Science, Università degli Studi di Bari Aldo Moro, Italy
- Department of Electrical and Information Engineering, Polytechnic University of Bari, Italy
- Department of Electronic Engineering, University of Rome Tor Vergata, Italy
- Institute of Cognitive Sciences and Technologies, National Research Council of Italy, Rome, Italy

Europa

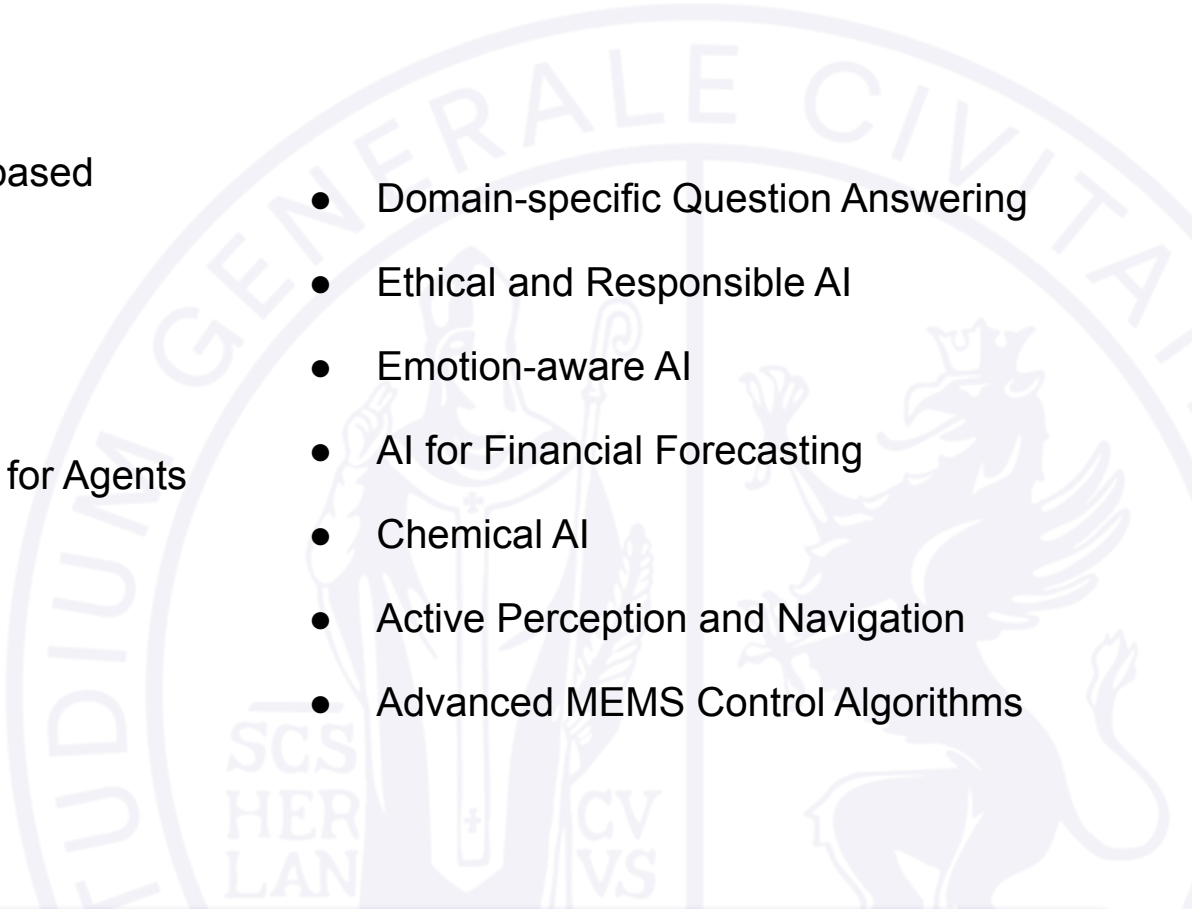
- French Institute for Research in Computer Science and Automation (Inria), Sophia Antipolis, France
- Department of Materials and Nanotechnology, AGH University of Science and Technology, Kraków, Poland
- Department of Computer Science, TU Darmstadt, Darmstadt, Germany
- Department of Computer Science, Université d’Artois (CRIL), Lens, France
- Department of Computer Science, Université Paris Cité (LIPADE), Paris, France
- Department of Computer Science, Université de Nantes, France
- Department of Computer Science, Université de Lille (CNRS), Lille, France
- Department of Molecular Biotechnology, Turkish-German University, Istanbul, Turkey

Resto del mondo

- Department of Molecular Medicine, University of South Florida, Tampa, USA
- Department of Computer Science, University of Texas at El Paso, El Paso, USA
- Department of Computer Science, University of Wyoming, USA
- Department of Management, Faculty of Management Sciences, Veritas University Abuja, Nigeria
- Department of Informatics, Graduate School of Informatics, Kyoto University, Japan

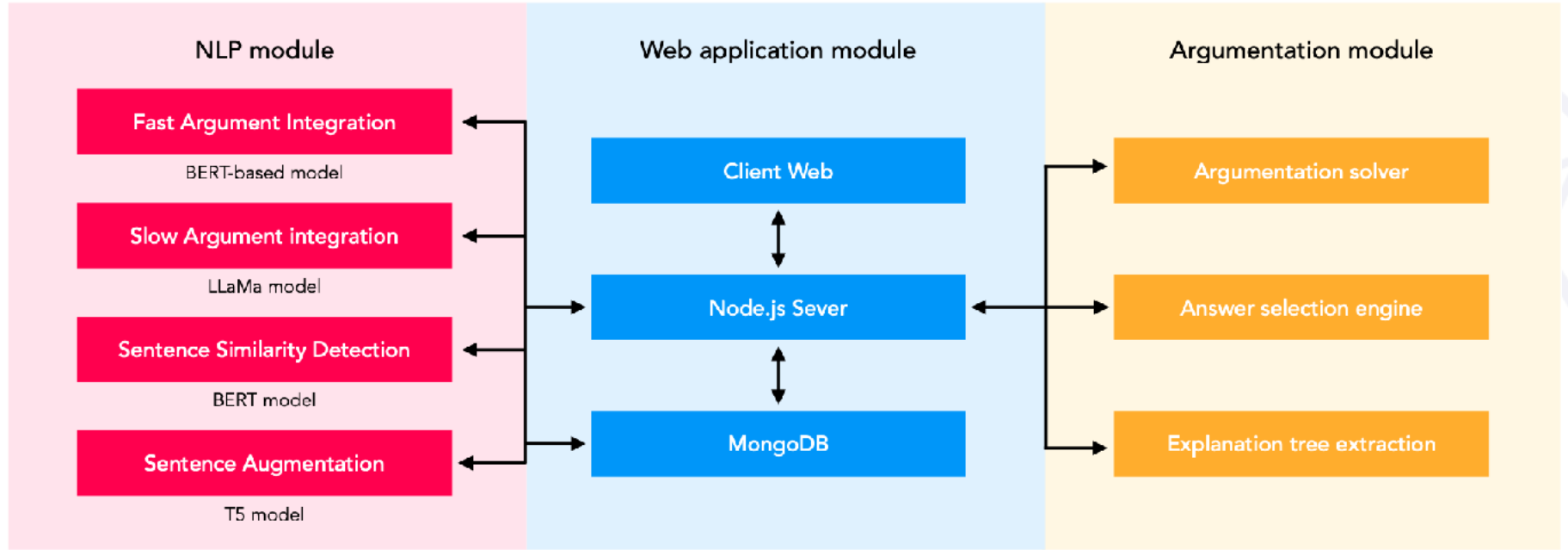
Attività del nodo



- 
- LLM and Argumentation-based Reasoning
 - Explainable AI
 - Multi-agent Reasoning
 - Concurrent Programming for Agents
 - Vision
 - Deepfake Generation
 - Conversational AI
 - Domain-specific Question Answering
 - Ethical and Responsible AI
 - Emotion-aware AI
 - AI for Financial Forecasting
 - Chemical AI
 - Active Perception and Navigation
 - Advanced MEMS Control Algorithms

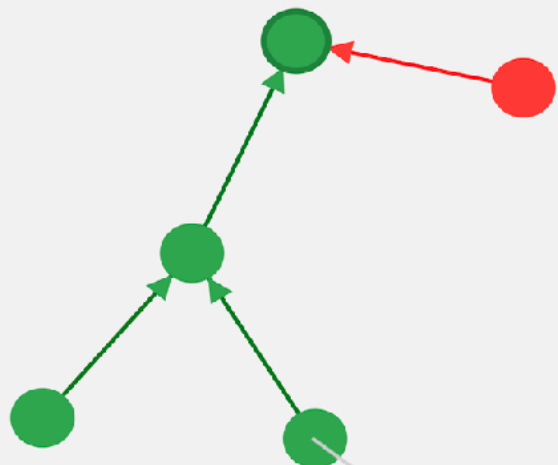


Integrating LLM and reasoning based on argumentation



Electric Vehicles

Set chatbot mode: **PRO** CON



Battery technology for EVs continues to improve, increasing their range and efficiency.

Electric vehicles (EVs) are more environmentally friendly than traditional gas-powered vehicles.

Electric vehicles still face challenges regarding battery disposal and recycling.

Electric vehicles contribute to energy diversification and reduce dependence on fossil fuels.

The infrastructure for charging electric vehicles is expanding globally

Battery technology for EVs continues to improve, increasing their range and efficiency.

Rel: **Attack** Support

Answer: **On** Off

Type your message...

Send

Arg-Xai: Argumentative Explanations for Machine Learning Outcomes

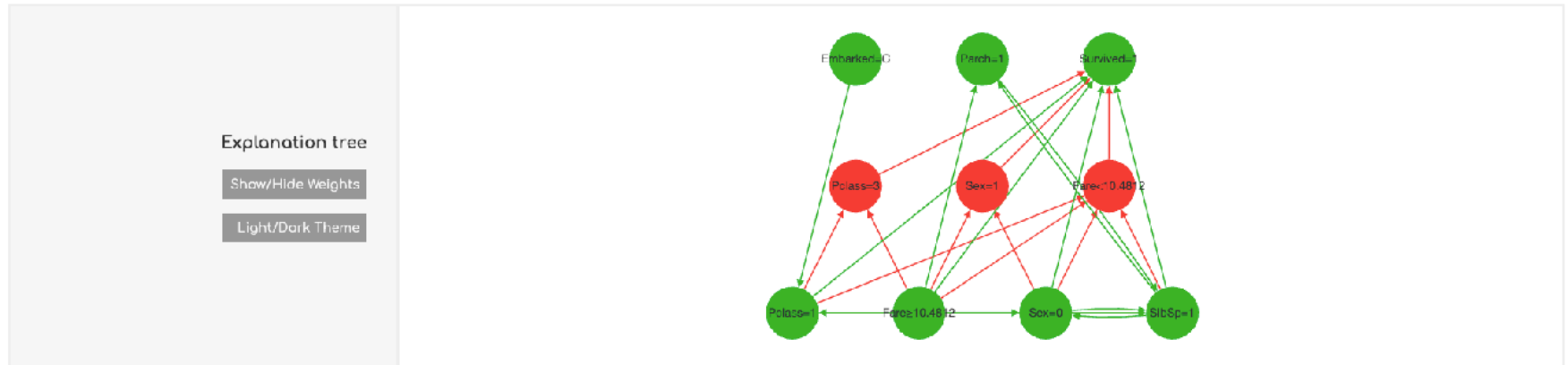
Step 8 - Compute Extensions and Probability

Feature to explain: Survived=1

Correlation threshold: 0.17

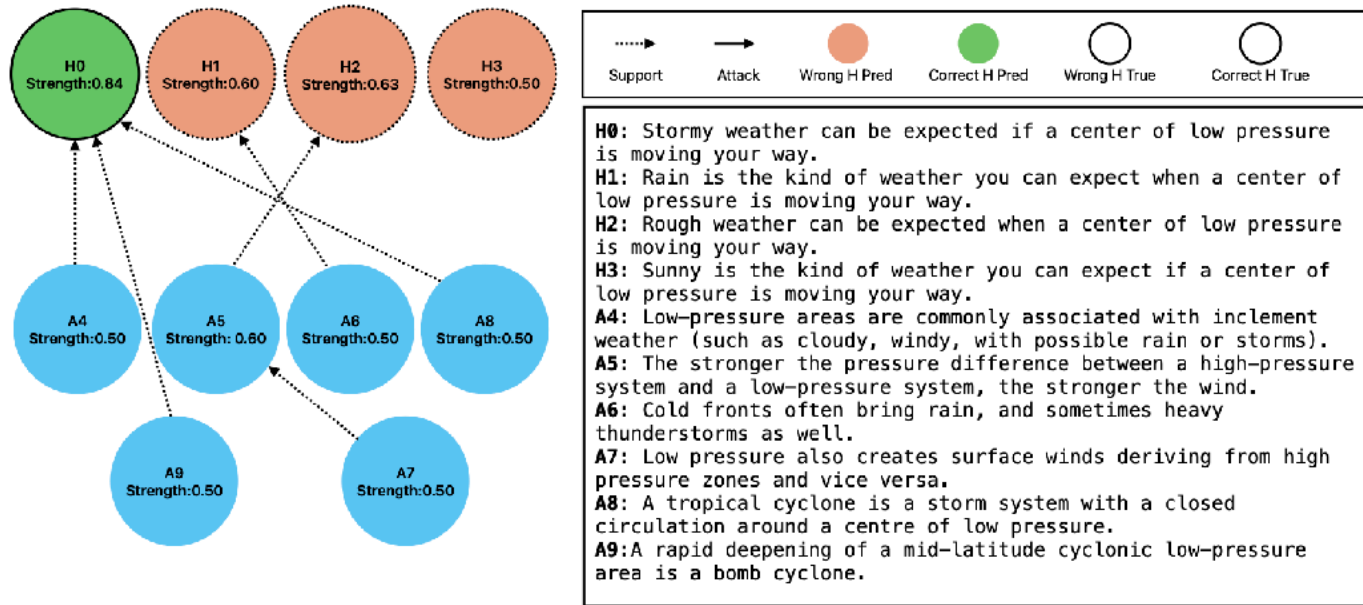
Edge removal threshold: 50

To identify the set of arguments which are more likely to be accepted, we compute the semi-stable extensions of the BAF and then, for each of them, its probability of being admissible.



- Dall'albero di spiegazione ottenuto è possibile leggere le motivazioni che hanno portato all'assegnazione di una certa etichetta
- Ogni path da una foglia alla radice è una possibile spiegazione

Explanation of the decision made





Linguaggio concorrente per l'argomentazione tra agenti

- Introduzione di CLA, un linguaggio per modellare interazioni tra agenti (es. persuasione e negoziazione) con esecuzione concorrente.
- Gli agenti condividono uno spazio argomentativo comune (AF) che rappresenta credenze e viene modificato aggiungendo/rimuovendo argomenti e attacchi.
- Implementazione con interfaccia web per simulare e studiare processi di argomentazione tra più agenti in parallelo

$P ::= C.A$
 $C ::= p(x) :: A|C.C$
 $A ::= success|add(Arg, R) \rightarrow A|rmv(Arg, R) \rightarrow A|E|A||A|\exists_x A|p(a, l, \sigma)$
 $E ::= E^w|E^f|E^j +_P E$
 $E^w ::= check^w(Arg, R) \rightarrow A|c-test^w(a, l, \sigma) \rightarrow A|s-test^w(a, l, \sigma) \rightarrow A|E^w + E^w$
 $E^f ::= check^f(Arg, R) \rightarrow A|c-test^f(a, l, \sigma) \rightarrow A|s-test^f(a, l, \sigma) \rightarrow A|E^f||_G E^f [failure]$

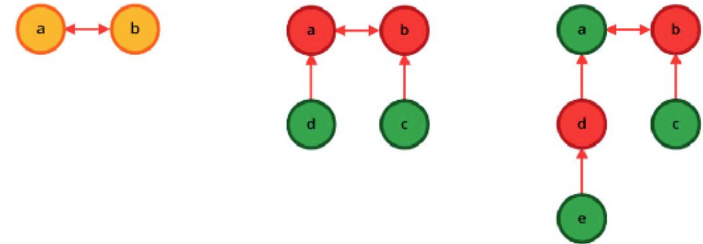


Fig. 10. AFs representing the evolution of a persuasion process from its beginning (on the left) to its conclusion (on the right).

Concurrent Language for Argumentation

Input Program (write or select)

```
add({a,b},{(a,b)}) -> success || checkf({k},{}) -> add({j},{}) -> success +P checkf({b},{}) -> add({k},{}) -> success +P testow({a},in,complete) -> add({v},{}) -> success;
```

Run All

Run 1 Step

 Program Output

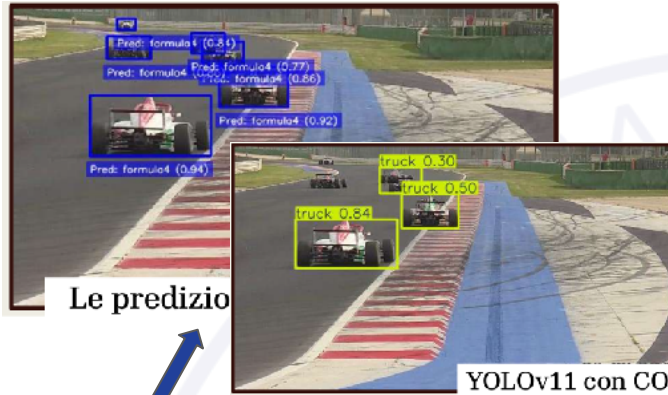
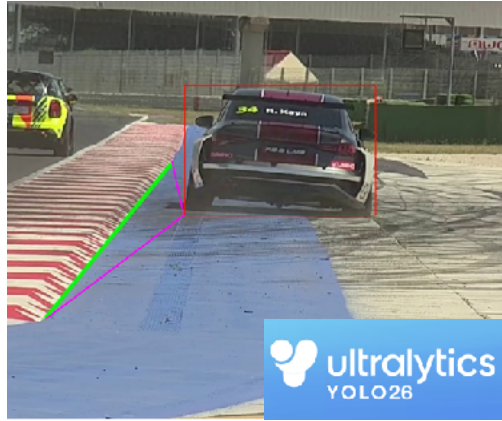
```
1 prg: add({a,b},{(a,b)})->success||checkf({k},{})->add({j},{})->success+Pcheckf({b},{})->add({k},{})->
  >success+Ptestow({a},in,complete)->add({v},{})->success;
2 par: add({a,b},{(a,b)})->success||checkf({k},{})->add({j},{})->success+Pcheckf({b},{})->add({k},{})->
  >success+Ptestow({a},in,complete)->add({v},{})->success
3 add: add({a,b},{(a,b)})->success
4 suc: success
5 ite: checkf({k},{})->add({j},{})->success+Pcheckf({b},{})->add({k},{})->success+Ptestow({a},in,complete)-
  >add({v},{})->success
6 ckf: checkf({k},{})->add({j},{})->success
7 Check failed
8 ckf: checkf({b},{})->add({k},{})->success
9 Check succeeded
10 add: add({k},{})->success
11 suc: success
12 SUCCESS
```

 Shared Memory

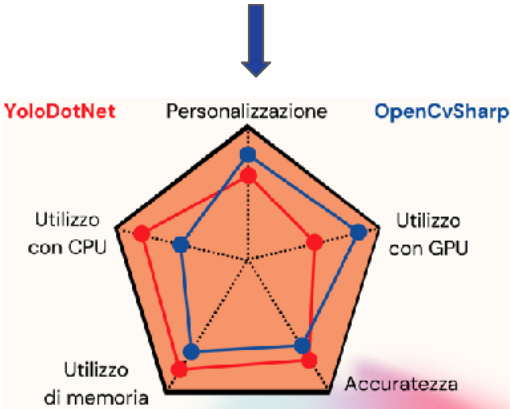
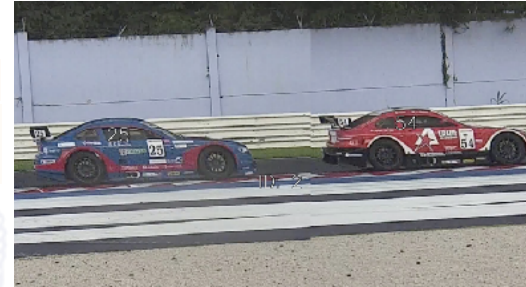
```
arg(a).
arg(b).
att(a,b).
arg(k).
```

Automatic Detection of Track-limits Violations





Predicted / True	formula4	gt	porsche	ter	prototypes	background
formula4	857					11
gt		797				2
porsche			715			8
ter		1		785		5
prototypes					764	9
background	27	6	1	3	8	null



Model (CPU)	Wrapper	Avg FPS	Min FPS	Max FPS
3x	YDN	13.96	12.67	15.66
3x	OCS	6.21	5.82	6.61

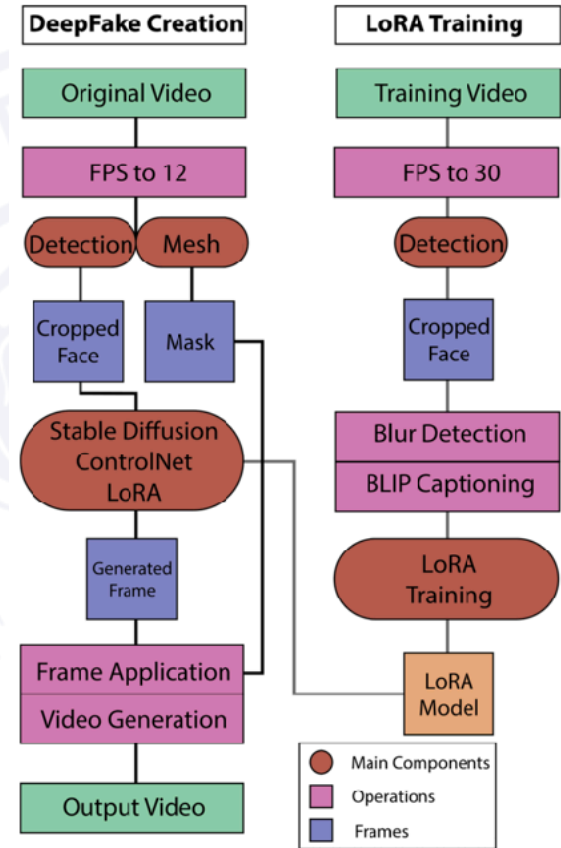
Model (GPU)	Wrapper	Avg FPS	Min FPS	Max FPS
0m	YDN	43.74	36.01	47.33
8m	OCS	62.24	47.41	70.22
8l	YDN	41.58	35.96	45.54
8l	OCS	60.03	48.01	63.90
8s	YDN	40.77	35.86	45.35
8x	OCS	48.94	44.8	51.87

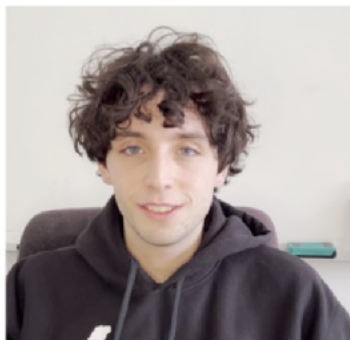


Generation of Deepfakes



- **Stable Diffusion** (a text-to-image diffusion model)
- **ControlNet** (adds conditional control to diffusion models)
- **LoRA** (efficient fine-tuning of large models)

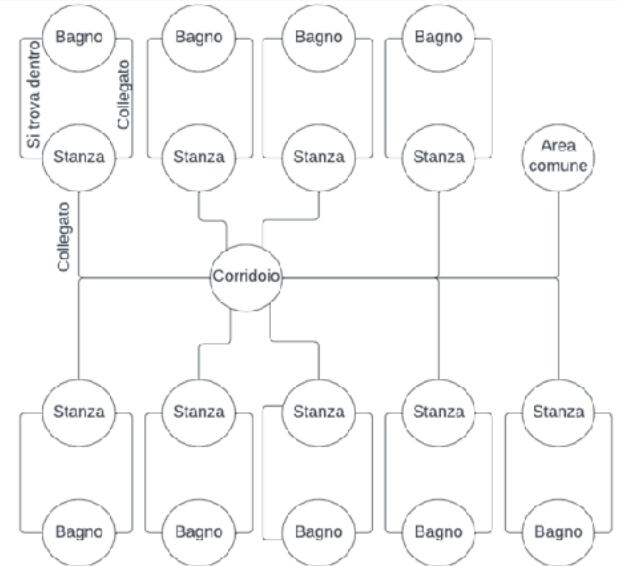




Chatbot for Tourism SMEs



- **Assistente virtuale** per strutture ricettive: check-in/out, informazioni su servizi e regolamenti, raccomandazioni su eventi e POI, navigazione indoor e urbana
- Tecnologie: **LLM** integrati con **Knowledge Graph**, dati **geospaziali** da OpenStreetMap, analisi di **planimetrie** tramite computer vision, approccio **RAG** (Retrieval-Augmented Generation)
- Moduli principali:
 1. Estrazione regolamenti → BERT + LLaMA
 2. Mappe urbane e strutture indoor → grafi semantici
 3. Tourism Knowledge Graph (es. Wikipedia + dataset pubblici)
- Benefici: risposte accurate e spiegabili, basso costo computazionale, scalabilità per PMI, estendibilità a musei, centri commerciali ed edifici pubblici



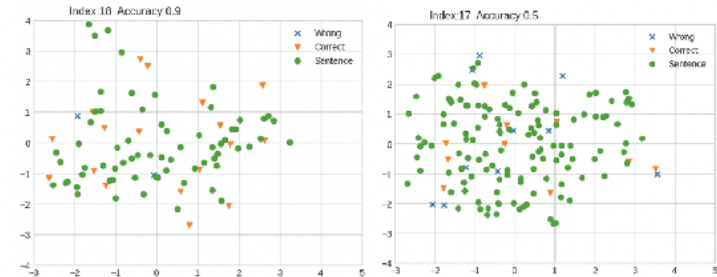
Question answering in close domain



Some of the hallucinations of Chat GPT in the hotel policy framework.

Index	Role	Text
1	Question	How does the text advise guests to handle their valuables for added security?
	Answer Chat GPT	The text does not specifically advise guests on how to handle their valuables for added security.
2	Question	Is there a specific age restriction for leaving children unattended in Hotel, and if so, what is it?
	Answer Chat GPT	The text does not specify a specific age restriction for leaving children unattended.
	Answer BERT	For safety reasons, it is not appropriate to leave children under 10 years of age without adult supervision in the room and other areas of Hotel

Embedding distribution produced by DistilBERT of a document with bad and good performance.



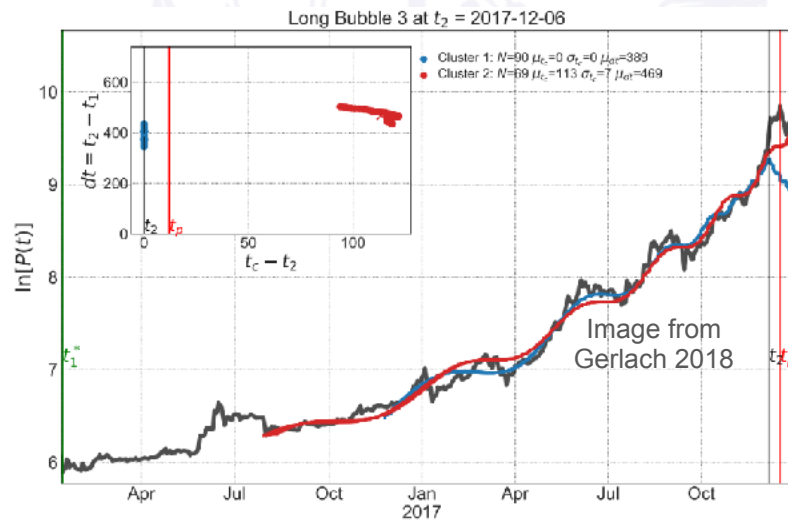
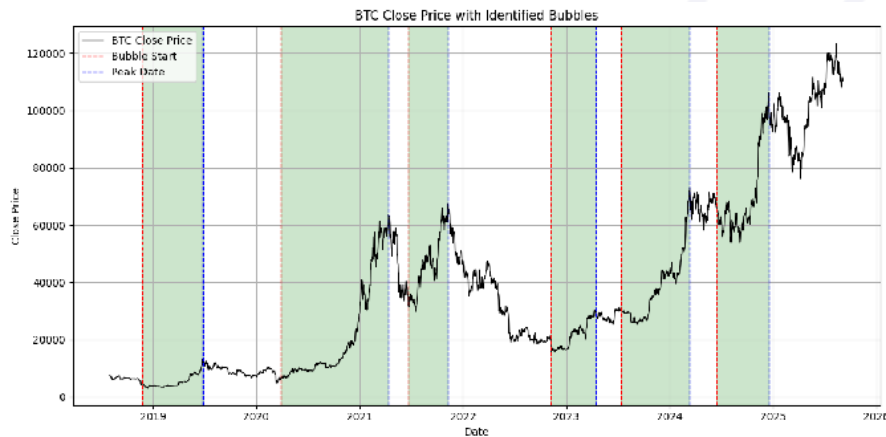
- **Semantic similarity** (Uses semantic similarity between the question and the relevant chunk of text to retrieve the answer)
- **Fast** (Uses a BERT-based method to efficiently retrieve the most relevant answer)
- **Secure** (Provides answers only from trusted sources (no generated content outside the knowledge base))
- **Explainable** (The answer is traceable to the retrieved text, ensuring transparency and verifiability)



Bitcoin Bubbles Crash Forecasting and Trading Strategy Implementation

Speculative Bubbles in Bitcoin

- Historical financial bubbles (Tulip, DotCom, etc.)
- **BSADF**: works only for bubble detection, **LPPLS**: econophysics framework for detection and crash time forecasting
- Once we are sufficiently confident that we are in a bubble we can predict its critical time
- We want to use this information to develop a trading strategy to be integrated in an automated trading system





**Emotions and Multidisciplinary-
Oriented Research on Ethical and
Responsible AI**

- Affective Computing, AI Ethics e Responsible AI: studio teorico e applicativo
- Modellazione computazionale di stati affettivi e cognitivi; analisi etica dei sistemi intelligenti
- Sviluppo e valutazione di applicazioni di IA etica in salute, educazione e contesti sociali
- Ricerca multidisciplinare e collaborativa: università, partner nazionali e internazionali, rete CINI “Smart Cities & Communities”



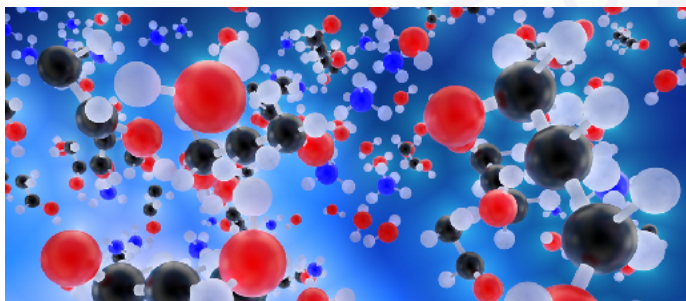
Chemical Artificial Intelligence



CHEMICAL ARTIFICIAL INTELLIGENCE (CAI)

HARDWARE:

MOLECULES AND
MACROMOLECULES



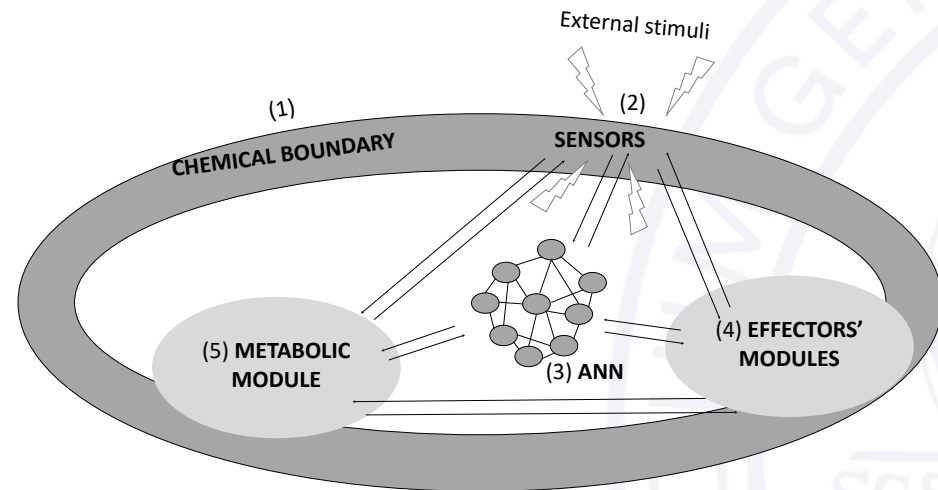
SOFTWARE:

CHEMICAL REACTIONS
CHEMICAL WAVES
DIFFUSION
MIGRATION
ADVECTION
CONVECTION

The HARDWARE and SOFTWARE of conventional AI are merged in the WETWARE of reactive chemical solutions maintained in out-of-equilibrium conditions.

CHEMICAL ROBOT: Confined Complex Chemical System

Why Chemical AI?



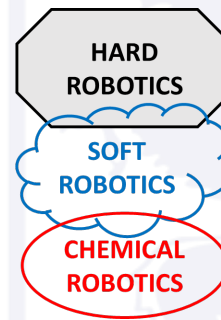
PROTOTYPES: WHITE BLOOD CELLS

- BIOMEDICAL APPLICATIONS

PROTOTYPES: MICRO-ORGANISMS

- SAFEGUARD THE ENVIRONMENT
- FORENSIC CHEMICAL TOXICOLOGICAL ANALYSES
- FACE PROBLEMS RELATED TO ENERGY AND FOOD SUPPLIES

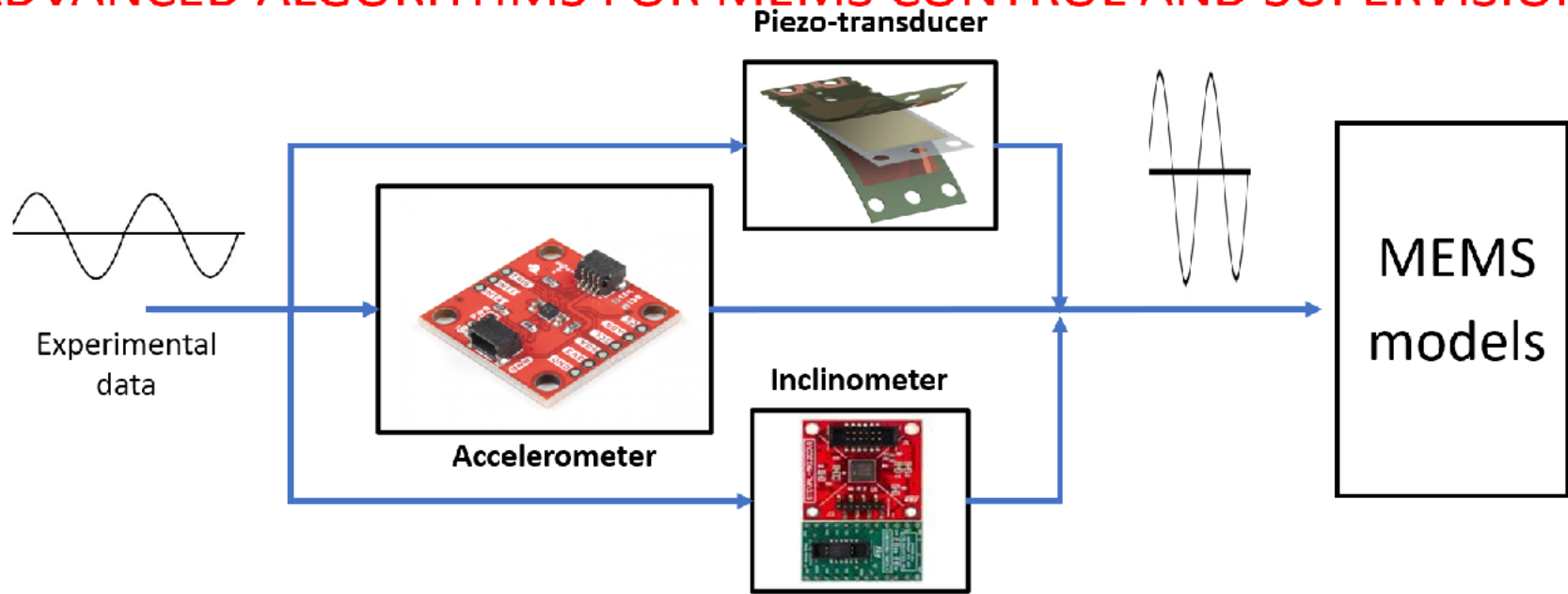
A NEW AVENUE IN ROBOTICS





Advanced Algorithms for Memos Control and Supervision

ADVANCED ALGORITHMS FOR MEMS CONTROL AND SUPERVISION

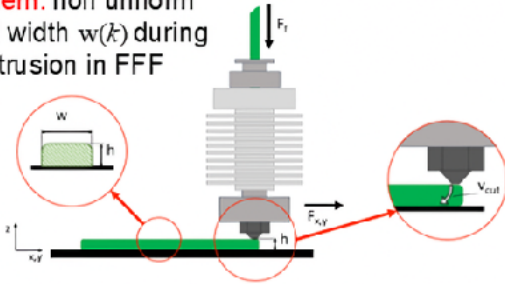


Implementation of real-time control and supervision algorithms

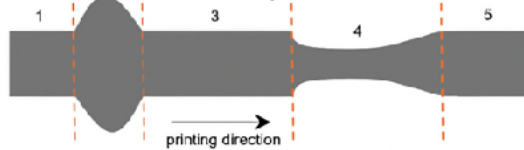
- Application of system identification techniques for data driven modeling.
- Modeling uncertainty characterization
- Development of feedback control algorithms for very low energy consumption MEMS devices
- Development of Fault detection algorithms for mems devices
- Monitoring of MEMS operation during operative life
- Development of intelligent tuning strategies

Data-Driven Reference Shaping for Optimal Fused Filament Fabrication

Problem: non uniform strand width $w(k)$ during extrusion in FFF

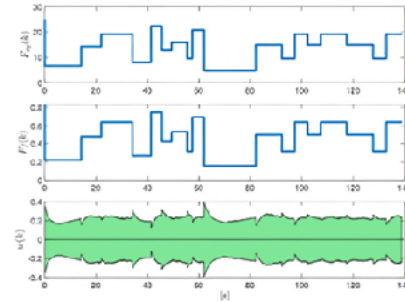


Consequences Over/Under extrusion problems



The main cause of non uniform width are the unoptimized reference commands for the:

- Print speed $F_{xy}(k)$
- Extrusion rate $F_{ex}(k)$



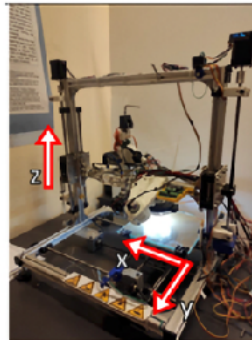
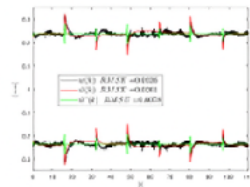
IDEA-1: Identify from data the dynamics between the 2 inputs: Print speed $F_{xy}(k)$ and Extrusion rate $F_{ex}(k)$ and 1 output: strand width $w(k)$

$$G_{xy}(\tau) = \frac{-0.061866 (1 + 5.935z^{-1}) (1 - 0.991z^{-1})}{(1 - 0.593z^{-1}) (1 + 0.02596z^{-1})}$$

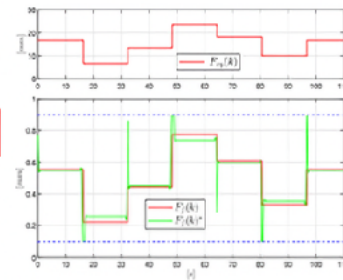
$$G_f(z) = \frac{0.0015043 z^{-1}}{(1 - 0.9877z^{-1}) (1 - 0.8006z^{-1})}$$

IDEA-2: The identified model is used to compute optimized shaped references to minimize strand width variations during FFF

Experimental Results: reduction of the **51% of the tracking error for $w(k)$**



experiments



Optimized profiles for $F_f(k)$

$$\begin{bmatrix} \Delta \hat{w}(1) \\ \Delta \hat{w}(2) \\ \Delta \hat{w}(3) \\ \Delta \hat{w}(4) \\ \dots \end{bmatrix} = \underbrace{\begin{bmatrix} CB & 0 & 0 & 0 & \dots \\ CAB & CB & 0 & 0 & \dots \\ CA^2B & CAB & CB & 0 & \dots \\ CA^3B & CA^2B & CAB & CB & \dots \\ \dots & \dots & \dots & \dots & \dots \end{bmatrix}}_M \underbrace{\begin{bmatrix} \Delta F_f(0) \\ \Delta F_f(1) \\ \Delta F_f(2) \\ \Delta F_f(3) \\ \dots \end{bmatrix}}_{\Delta F_f}$$

$$+ \underbrace{\begin{bmatrix} CA \\ CA^2 \\ CA^3 \\ CA^4 \\ \dots \end{bmatrix}}_{z_0} x(0) + \underbrace{\begin{bmatrix} \Delta d(1) \\ \Delta d(2) \\ \Delta d(3) \\ \Delta d(4) \\ \dots \end{bmatrix}}_{z_0}$$

Enhanced sensor fault detection in bridge monitoring using Siamese-based encoder-decoder

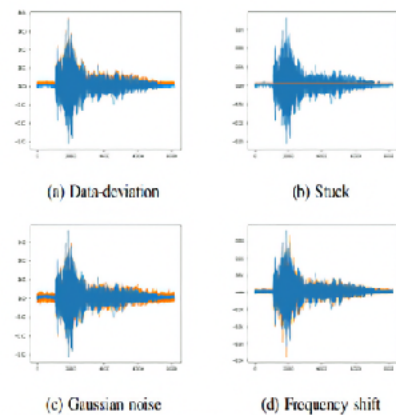
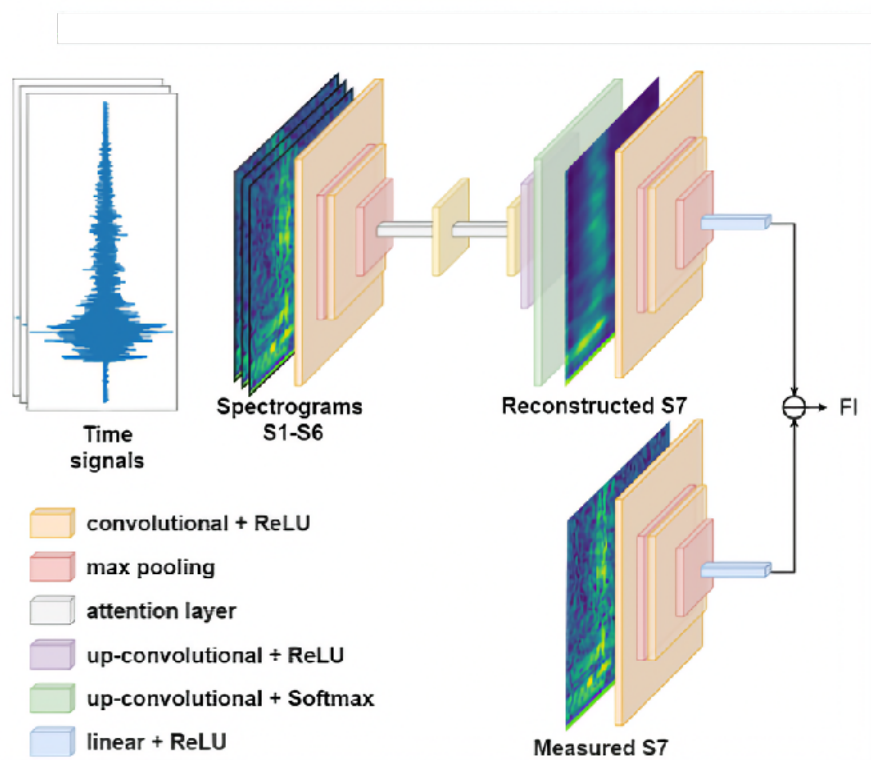


Fig. 4: Examples of fault-free signals (in blue) compared to the corrupted version (in orange) after fault injection.

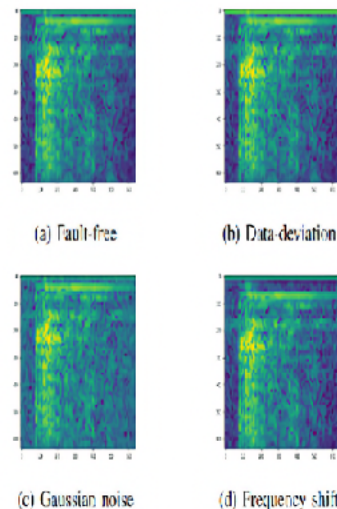


Fig. 5: Examples of the fault-free (Sa) and altered spectrograms (Sb-5d) after fault injection.

MangoDetNet: a novel label-efficient weakly supervised fruit detection framework

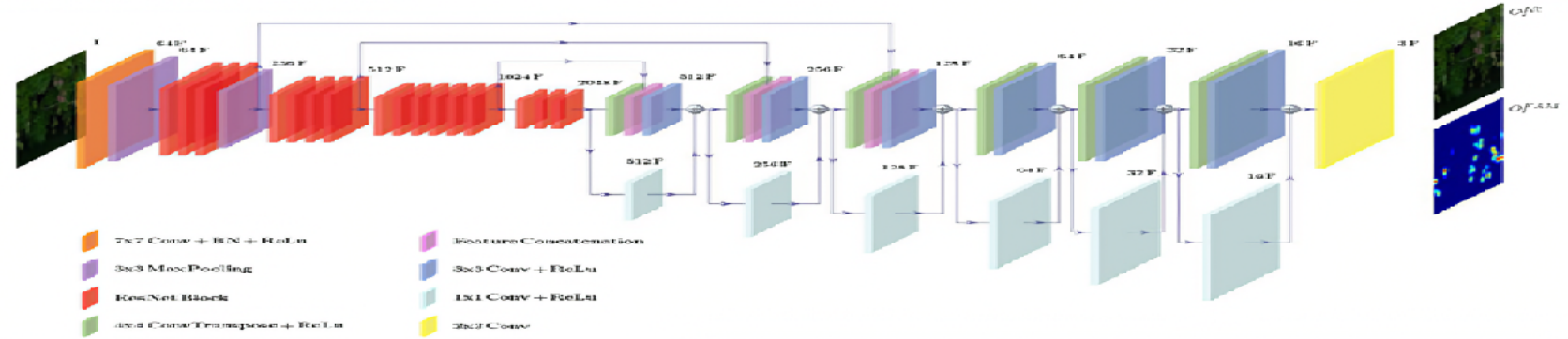
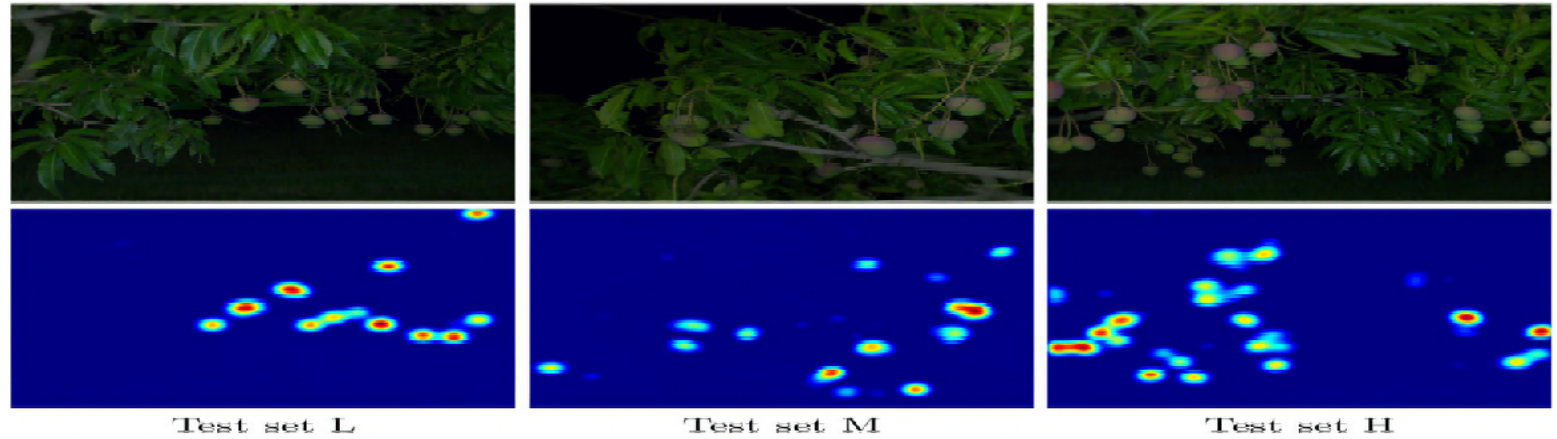


Fig. 1 Encoder-decoder architecture overview.

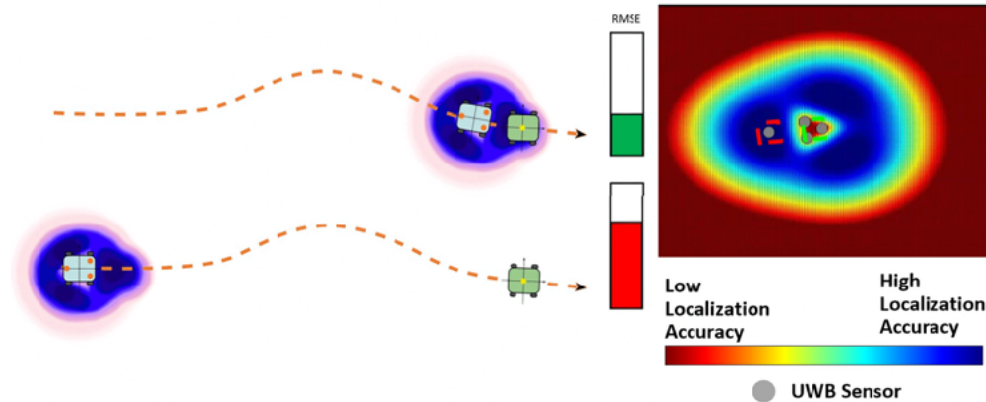


Learning to Actively Perceive and Navigate



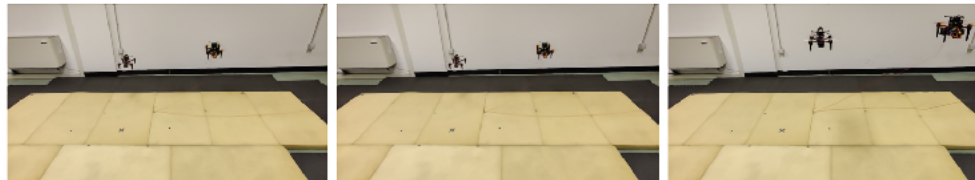
UWB-based Active Relative Localization

- DRL-based active approach to maintain the TagBot within the area where the Geometric Dilution of Precision (GDOP) is minimum. The agent is trained in simulation and deployed in real scenarios with zero shot adaptation



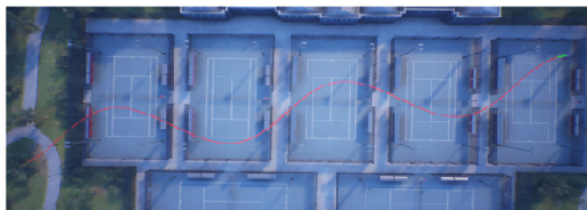
Visual Active Tracking

- Develop a DRL-based approach that computes continuous control actions to track a target robot (MAV) by using only vision information.



Vision-based trajectory tracking and collision avoidance

- Develop autonomous navigation strategies for Micro Aerial Vehicles (MAVs)
- Precise trajectory tracking ensuring effective collision avoidance in complex environments



Autonomous Navigation based on audio-visual information

- Develop autonomous navigation methodologies for vehicles by integrating multimodal perception)
- Include visual and auditory data to improve situational awareness and anticipation of occluded events.



Grazie dell'attenzione

