AI for Autonomous UAV Systems

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The PRISMA Lab Group

AI FOR AUTONOMOUS UAV SYSTEMS

- 3 full professors, 3 associate professor, 3 assistant professors
- 20+ post-docs, PhD students
- 35+ years of research activity
- 1.4 M€ financial support a year (from competitive projects)
- Collaboration with 150+ foreign institutions & companies

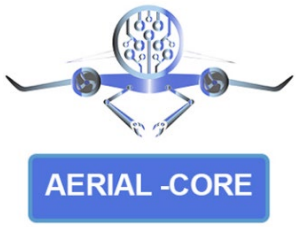
Our topics:

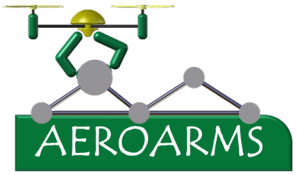
- **Aerial Robotics**
- **AI and Cognitive Robotics**
- **Human-Robot Interaction**
- Dynamic Manipulation and Legged Robotics
- Industrial Robotics
- Medical Robotics

Neabotics
Service Robotics Solutions

Research Projects on Aerial Robotics

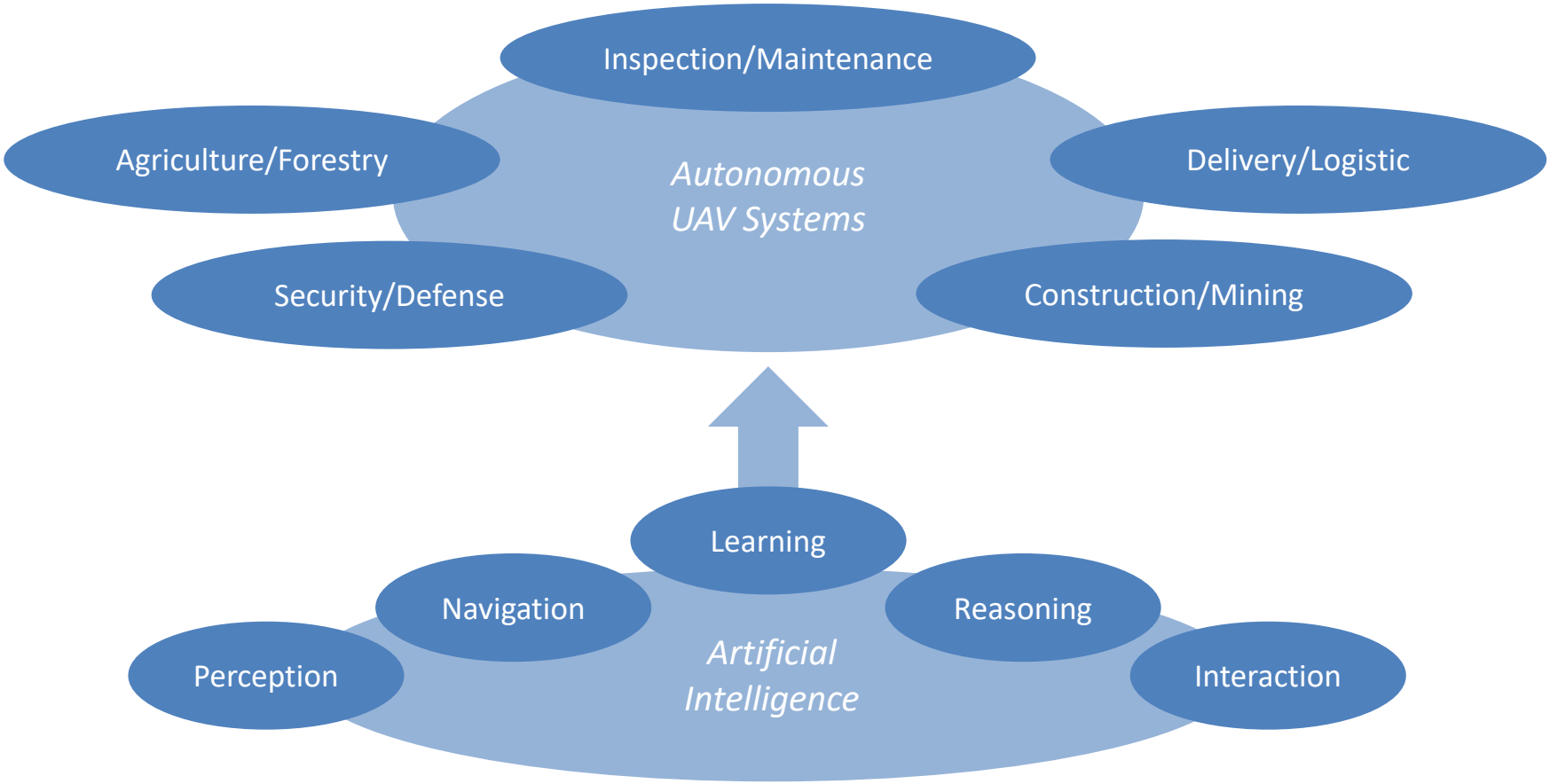
AI FOR AUTONOMOUS UAV SYSTEMS



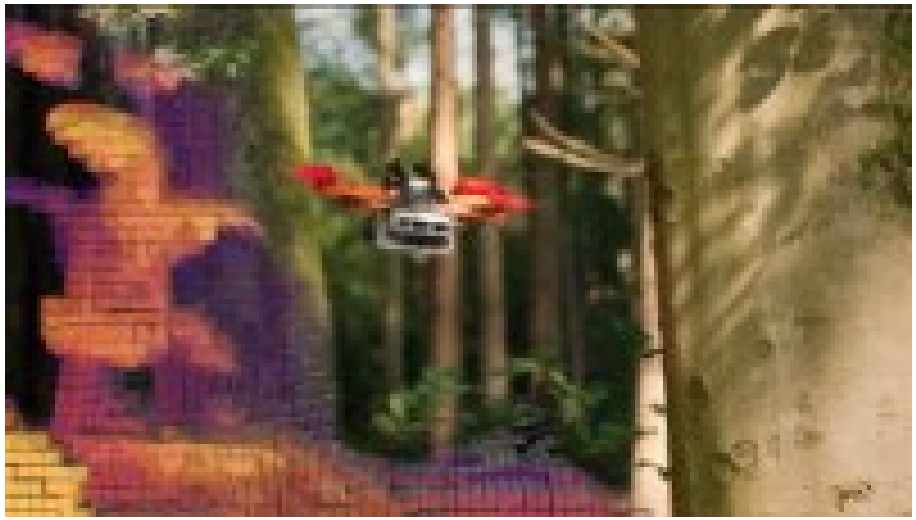


AI and Autonomy

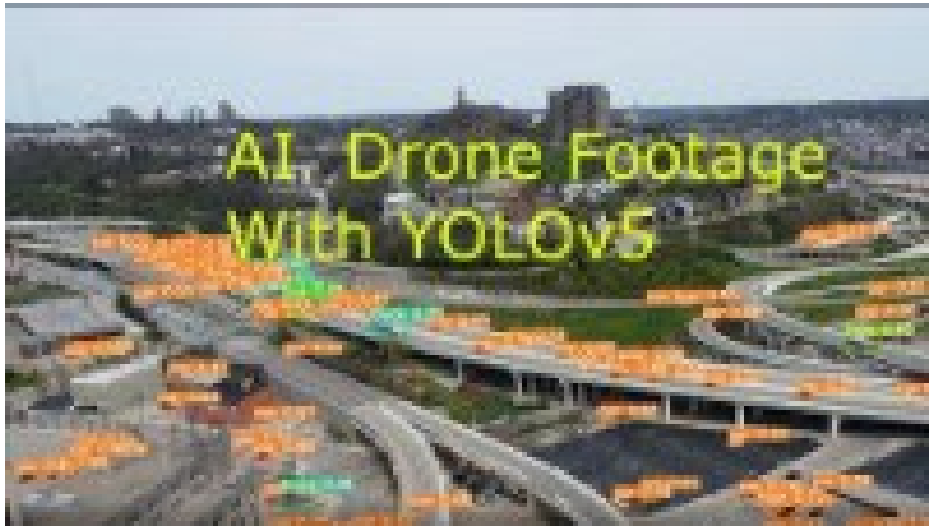
- Global autonomous UAV market is projected to grow from USD 15.5 billion in 2022 to USD 56.5 billion by 2030 *[Yahoo Finance]*.



AI for Navigation and Perception



High-speed autonomous navigation in cluttered outdoor environments



On-line recognition and localization of multiple objects using cameras

[1] Loquercio, Antonio, et al. "Learning high-speed flight in the wild." Science Robotics 6.59 (2021).
[2] Redmon, Joseph, et al. "You only look once: Unified, real-time object detection." Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.

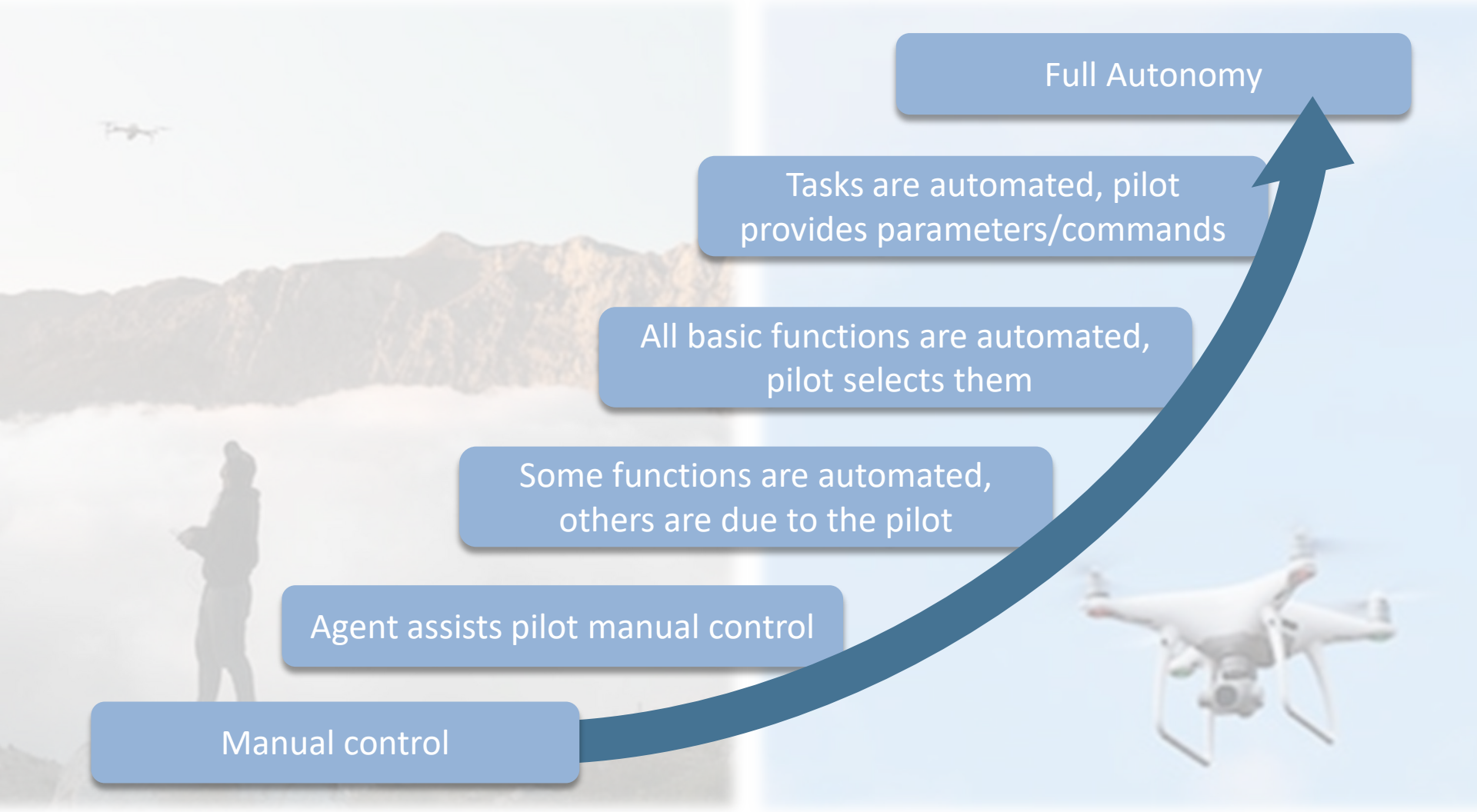
Interaction and Manipulation

Physical interaction with the environment during flight

Aerial manipulation and transportation of objects

[3] AEROARMS (AErial RObotic system integrating multiple ARMS and advanced manipulation capabilities for inspection and maintenance) EU Project.

Levels of Autonomy



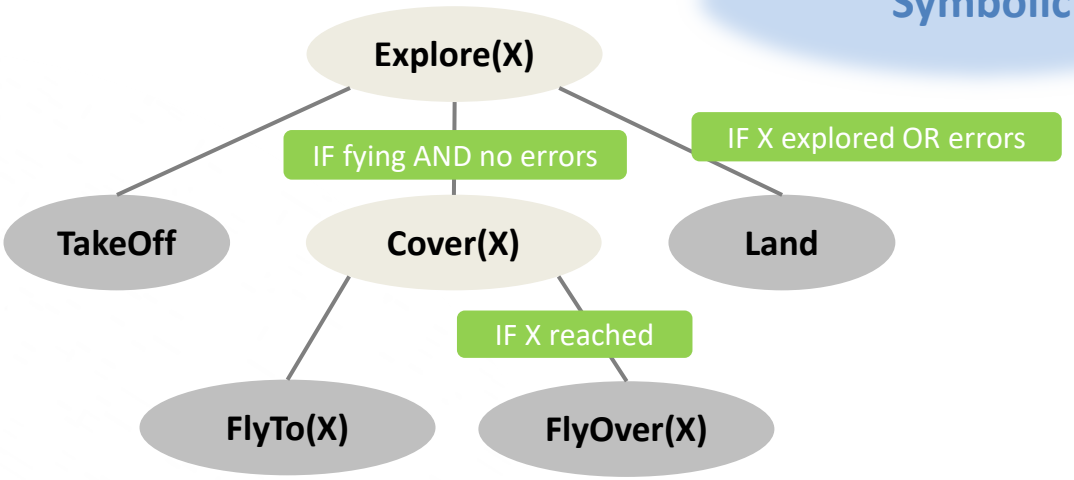
Multi-agent coordination and construction

Multi-agent collaboration during structured tasks

[4] Gramazio and Kohler, ETH Zurich.
[5] ARCAS (Aerial Robotic Cooperative Assembly System) EU Project.

Symbolic vs. Sub-symbolic Systems

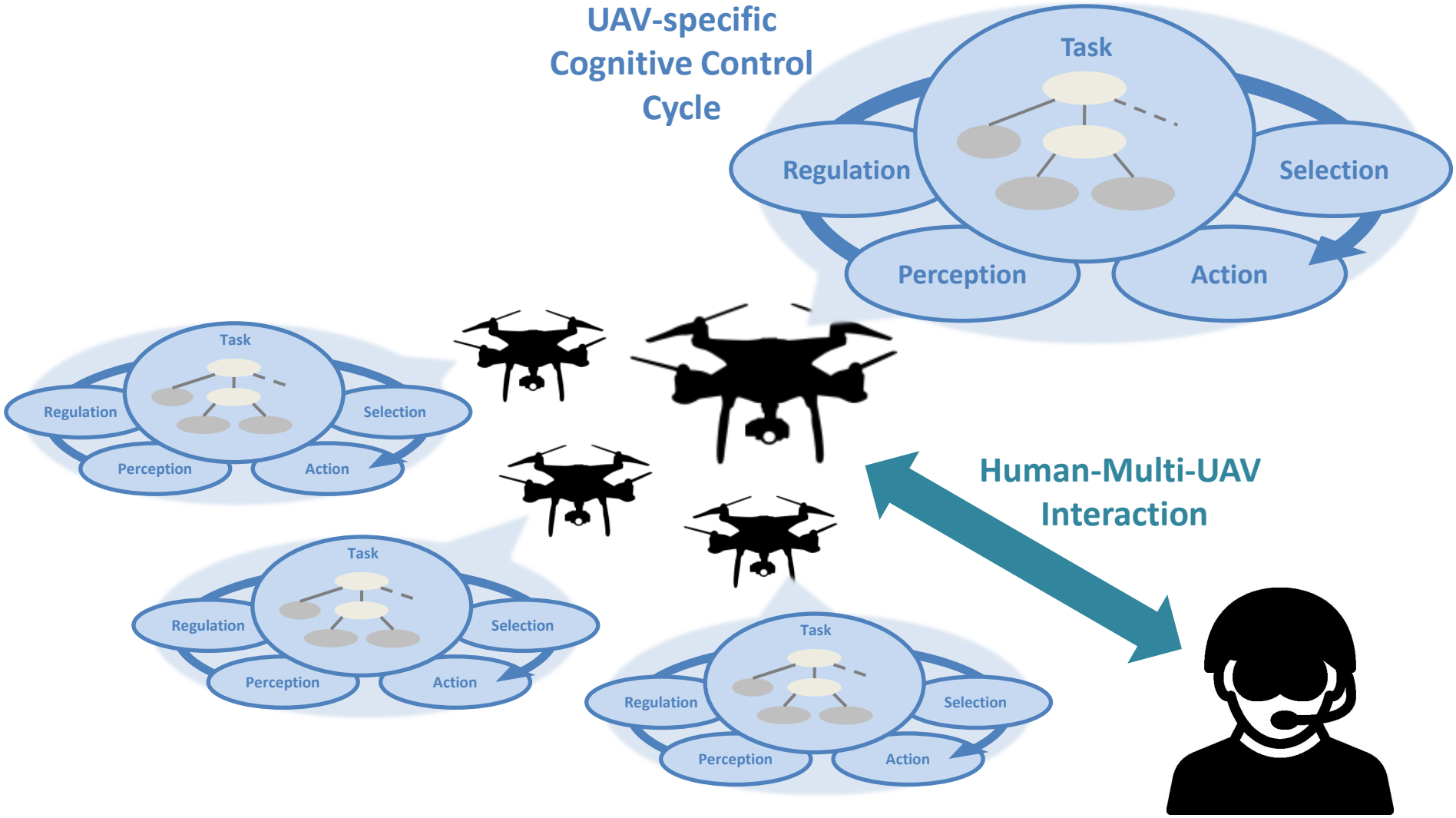
Symbolic



Hybrid

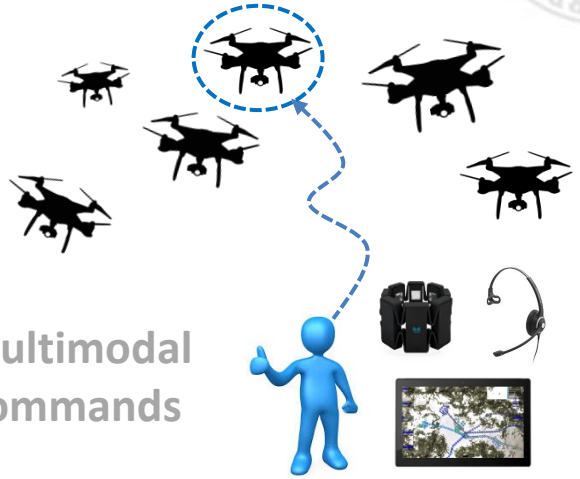
Sub-symbolic

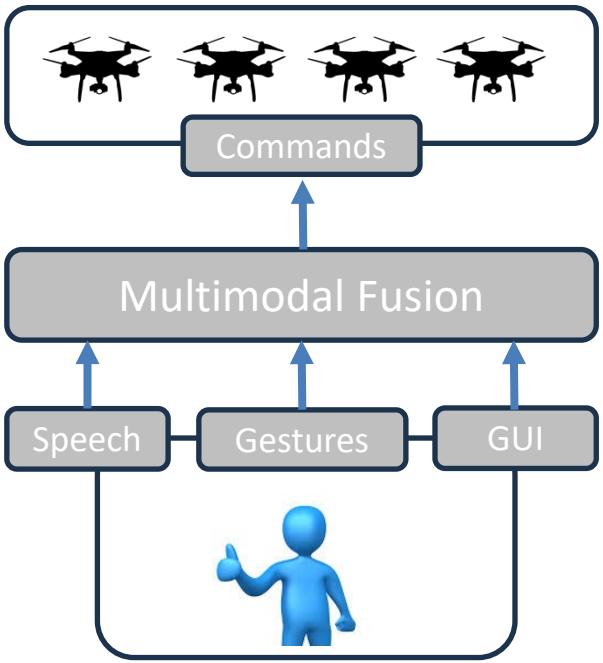
AI and Cognitive UAV Systems

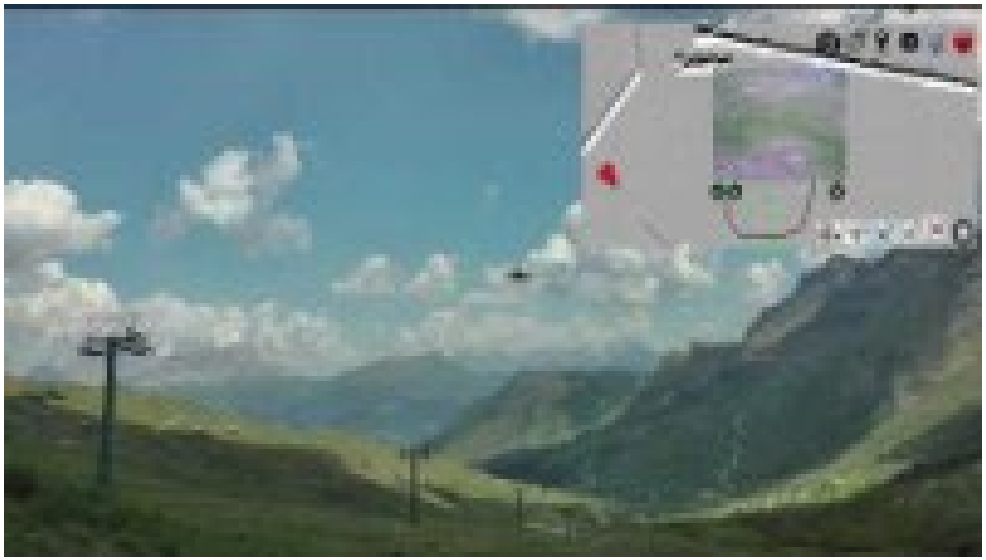


Human-UAVs Interaction

- Interpretation of the single modalities.
- Multimodal fusion into multi-agent commands.
- Autonomous execution of high-level commands



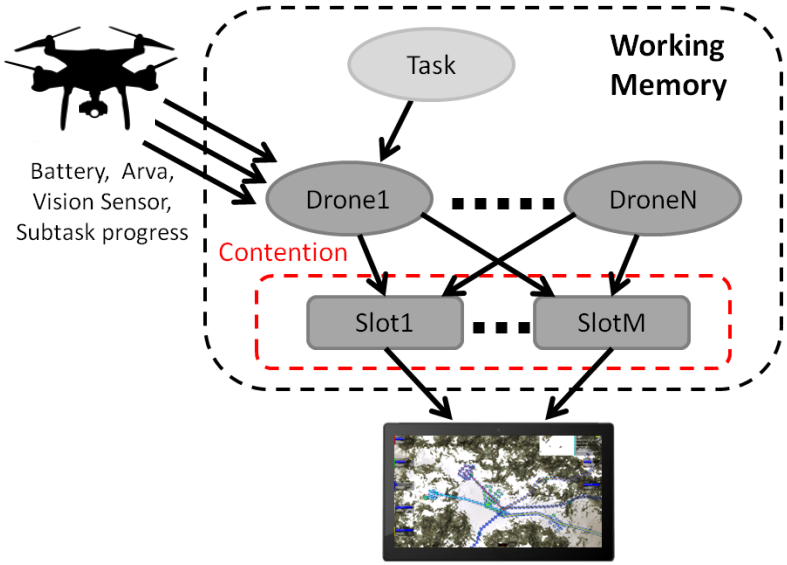


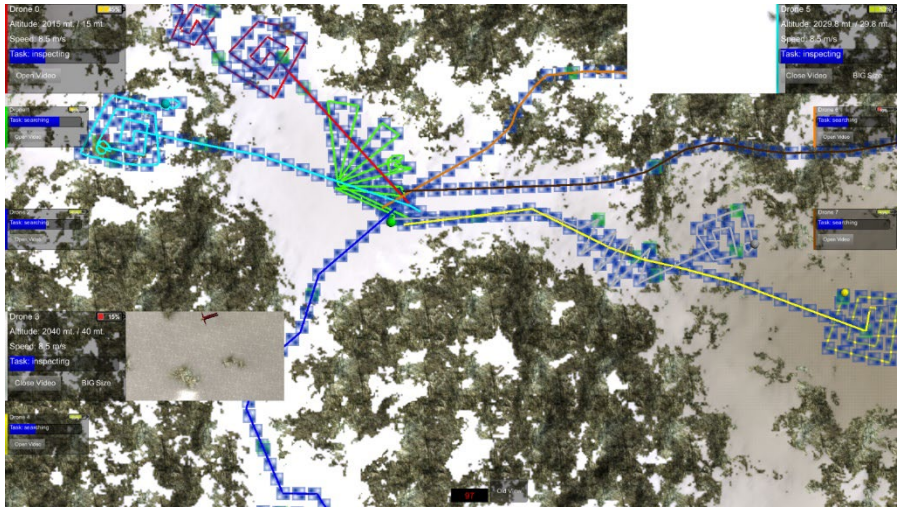


[6] Cacace, Jonathan, et al. "A Control Architecture for Multiple Drones Operated via Multimodal Interaction in Search & Rescue Mission".

Human-UAVs Interaction

- Task-based and senor-based importance to actions and subtasks.
- User's attention modelled as a shared resource between UAVs.
- User's cognitive load regulates communication slots.



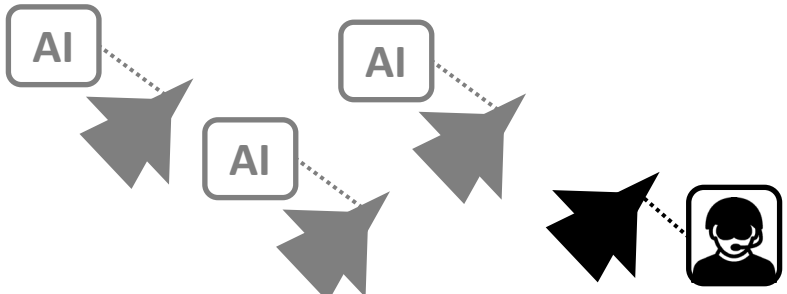


[7] Cacace, Jonathan, et al. "Attentional Multimodal Interface for Multidrone Search in the Alps".

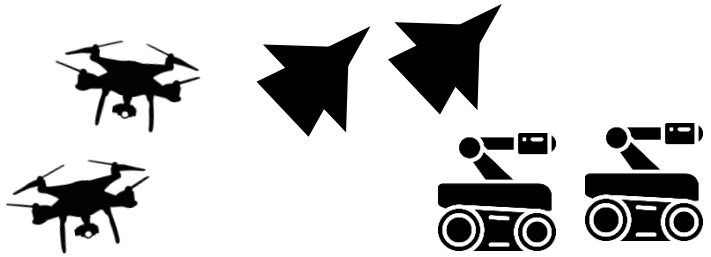
Research Directions

AI FOR AUTONOMOUS UAV SYSTEMS

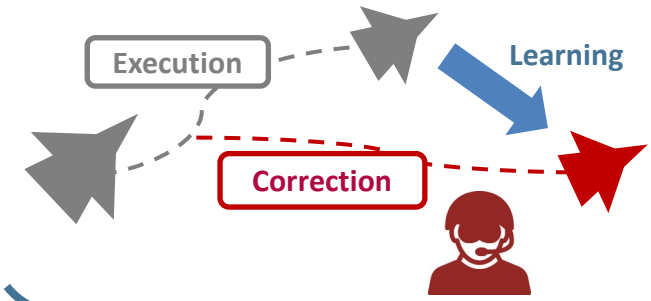
Manned-Unmanned Teaming



Heterogeneous Teams



Learning by Demonstration



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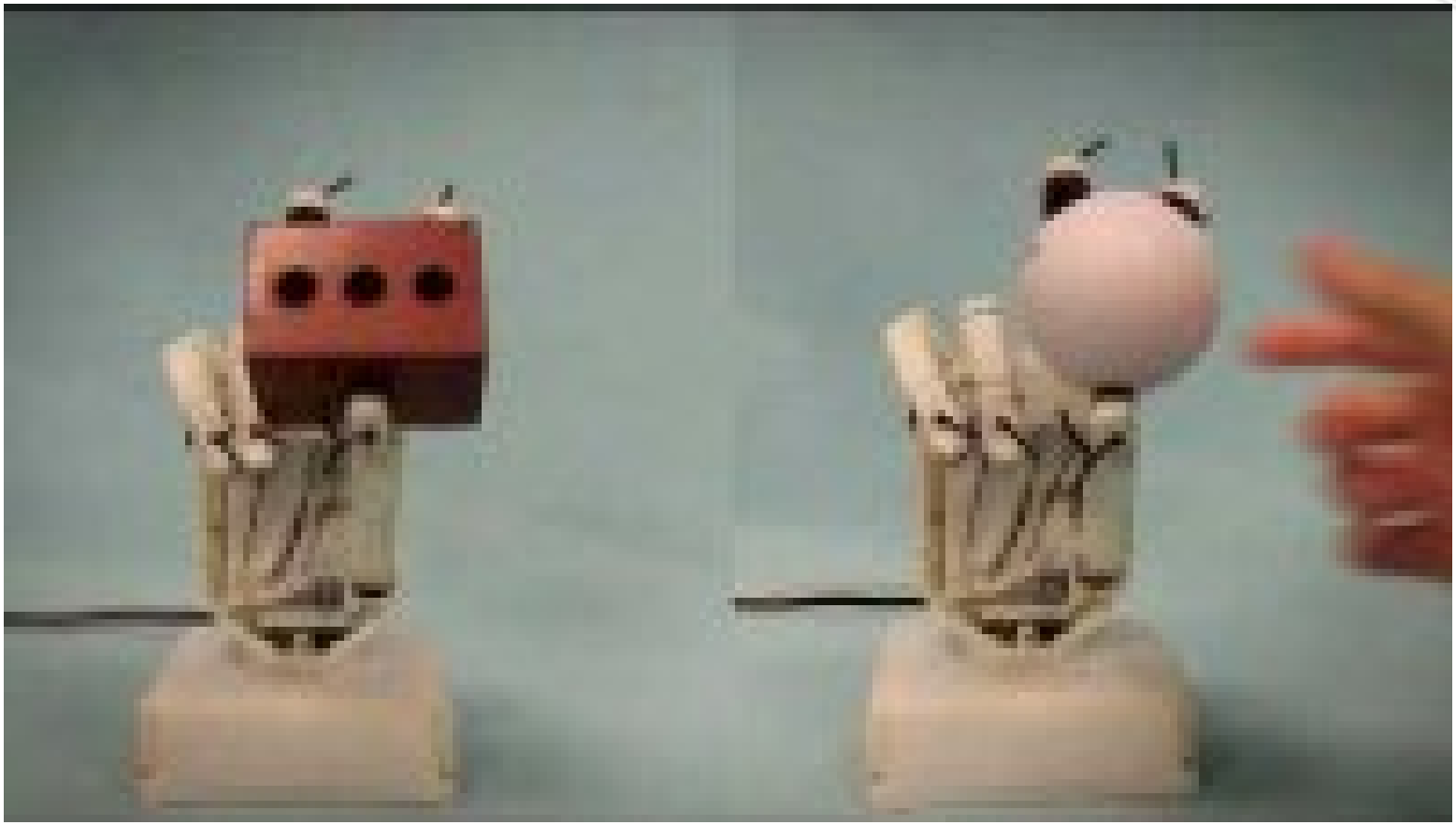

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