ADRA's Policy Paper and Technology Roadmap on GenAI for Robotics

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Policy Paper and Technology Roadmap GenAI and Robotics 4EU

- Rapidly advancing GenAI development

- The European Commission aims to maximize Europe's benefits from advancements in AI, Data and Robotics

- ADRA, federating European AI, Data and Robotics ecosystem, entrusted with the task:
  - Policy paper -> Where we are?
  - Roadmap -> Where Europe should go?
    - Mobilized 50 Researchers and 40 Industry Stakeholders, from 12 member states
    - Step towards European AI-Powered Robotics Strategy

GenAI and Robotics are Converging

- GenAI and Robotics are general purpose technologies

- Empowering each other

- Emergence of

  - New complex robotic system

  - Next level of interaction with the robot

  - New markets for robots

GenAI Empowers Robotics

- Bridges the Sim-to-Real gap -> Better understanding of the environment
  - GenAI-simulated environments are more realistic and detailed, enabling more accurate testing, training, and validation of robotic systems.
- Bridges the Robots - Datasets gap -> Efficiency gain while performing new tasks
  - Robot programming is evolving. Instead of traditional programming, we'll use consolidated datasets to train robots for various tasks, even those they weren't initially trained for
- Bridges the Robots-to-Humans gap -> Robots easier to use, to interact with
  - Advances in multi-modal generative models enhance robots' ability to understand high-level human commands, enabling more effective collaboration
- Co-designing new robots -> More flexible & dynamic robots for specific needs
  - Based on predefined criteria, GenAI can design the sub-systems, components, and program of new robots and robotic systems

Robotics Empowers GenAI

- Explore and interact with the physical world

- Has access to real-world multimodal data
  - Coming from various sensors and various environments, including industrial operations, hostile or inaccessible environments or human-robot interaction

- Investigate the fields unexplored till now

- Develop adaptive intelligence

- AI embodiment

Critical Challenges and European Approach

- Safety
  - Safety by design: testing in various generated situations
  - High-level of explainability, guarantees and/or certifications
  - Specific learning methods and new approaches to keep the system within its operational bounds

- Trustworthiness
  - Explainability, reliability
  - Quality
  - Embodiment and real-time interaction

- Cybersecurity

- Energy efficiency
  - Enormous energy cost of learning and inference
  - Frugal AI to avoid exponential growth in data and computational requirements

- Europe shall not enter the race on the same terms as the USA and China, characterised by mass investment, big data and immense compute power
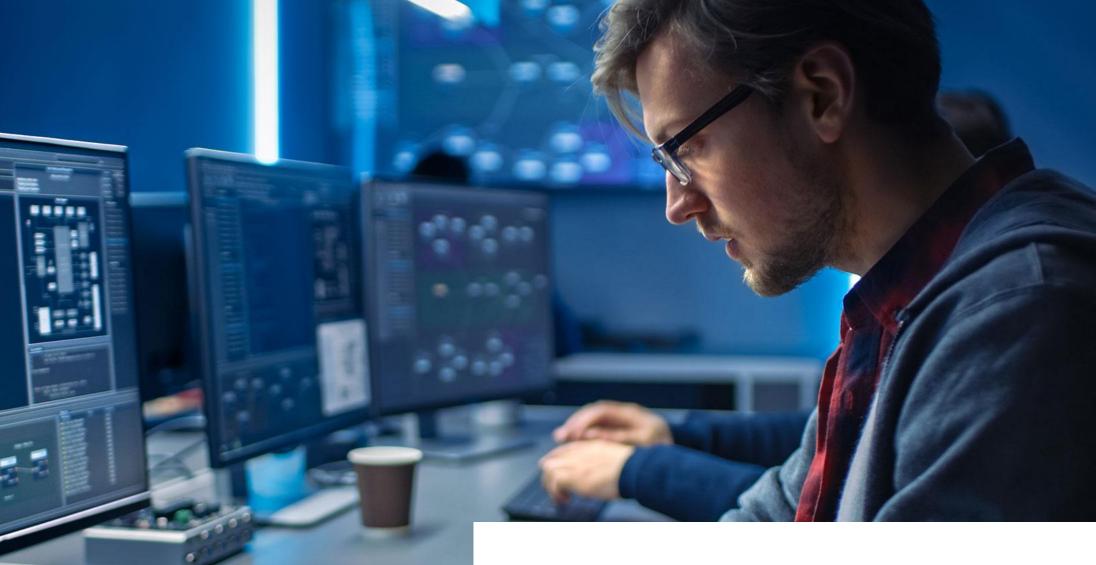
Generative AI in inspection and maintenance

- High level of autonomy
    - I&M tasks with a large variety of geometries and appearances
    - GenAI can help in understanding the environment and adapt the robot's behaviour

- Ease of adoption
    - Reducing deployment time, less robot training, and less human intervention

- Ease of operation
    - More intuitive human-robot interfaces

- Market gain
    - Tailored solutions for the customers without meticulous setting up

- Starting point -> Strong Europe presence in this sector
    - Short-term -> faster anomalies detection from sensors' data stream
    - Mid-term -> mission planning and human robot interfaces
    - Long-term -> full robot autonomy stack

Generative AI in inspection and maintenance

- What are the currently demonstrated capabilities and limitations of applying GenAI for I&M and other sectors, and how is the use in other sectors relevant for I&M?

  - Easier way of programming the robots

  - Scarcity of real-world data for training

- What are the high-impact I&M use cases for GenAI in the industry and public sector? Both low-hanging fruits and more advanced use cases.

- What is the research, development and innovation challenges to tackle next to boost European competitiveness for GenAI in I&M?

  - Multimodal-models and reliable data for training

  - Reliability, Robustness and Safety of the systems

Thank you for your attention!