OpenDR: Open Deep Learning Toolkit for Robotics

OpenDR Deep Robotics

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871449

OpenDR at a glance

- H2020 Research and Innovation Action
- Coordinated by Aristotle University of Thessaloniki (Prof. Anastasios Tefas)
- 8 Partners from 7 European countries
- 6.6 M € budget (EU funding)
- Start date: January 1st 2020, duration: 36 months

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Deep Robotics

OpenDR context

Deep Learning in robotics leads to research questions that are typically not fully addressed within the deep learning community

Steep Learning Curve
Difficult for robotics laboratories/companies to employ deep learning methodologies to their research/products

Computational complexity
DL requires powerful and specialized hardware which makes using DL models on embedded systems difficult

Passive Perception
Traditional Computer Vision approaches do not consider the interaction between a robot and the world

Provide a modular, open easy-to-use toolkit

Provide lightweight DL models

Provide active perception DL methods

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OpenDR Deep Robotics

OpenDR overall objectives

To develop a **modular**, **open**, and **non-proprietary toolkit** for **core robotic functionalities** by harnessing **deep learning** to provide **advanced perception** and **cognition capabilities**, meeting in this way the **general requirements of robotics applications** in different areas.

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OpenDR technical objectives

Overcoming the **learning curve barrier**	Overcoming the **computational complexity barrier**	Overcoming the **passive perception barrier**
A library with a collection of **ROS nodes** and the necessary **tools for training and deployment** will be developed that will enable **any ROS-based robotic architecture to easily integrate them for improving its technical capabilities.**	State-of-the-art **lightweight deep learning models** will be developed building upon the **strong expertise of the involved partners**. Models will provide **real-time inference** on **embedded systems**, while being able to process **high-resolution data.**	OpenDR aims to be the first project that will provide **a complete framework for simulating and developing robotics applications** that use **deep learning methodologies.** OpenDR will also provide **tools** for **enhanced robot navigation, action and manipulation capabilities.**

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OpenDR expected impact

- Improve the technical capabilities in robotics by providing easily deployable, efficient and novel DL tools
- Enable a greater range of cognitive applications in agri-food, healthcare robotics and agile production (TRL 3+)
- Lower the technical barriers by providing a modular and open platform for developing DL models
- Strengthen the competitiveness of companies by lowering the cost to access robotics-oriented DL tools

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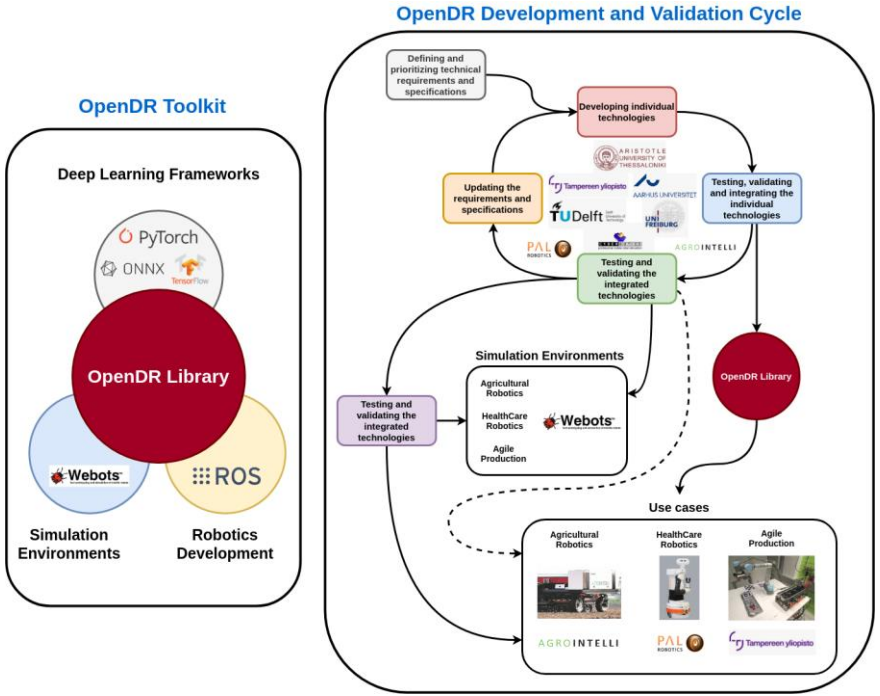
OpenDR ecosystem & development cycles



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OpenDR Deep Robotics

OpenDR workplan

- **Divided into 10 work packages (WP)**
- **WP 1** is dealing with **project administration**
- **WP 9** will deal with **disseminating** the research results through various channels (publications, links with robotics DIHs, exhibitions, ...)
- **WP 10** will ensure **compliance with ethics requirements**

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Deep Robotics

OpenDR workplan

- **WP 2** will deal with the **requirements** and **specifications** of the **toolkit** and the **specific use cases**
- **WPs 3 to 5** will provide **lightweight active perception**-based deep learning methods for **human-centric and environment perception** and **cognition**, as well as **robot action and decision making**
- **WP 6** will provide a **simulation framework** aimed at training **OpenDR tools**
- **WP 7 and 8** will **integrate** and **evaluate** OpenDR toolkit in **simulation** and **real world environments** and **ensure its portability across various systems**

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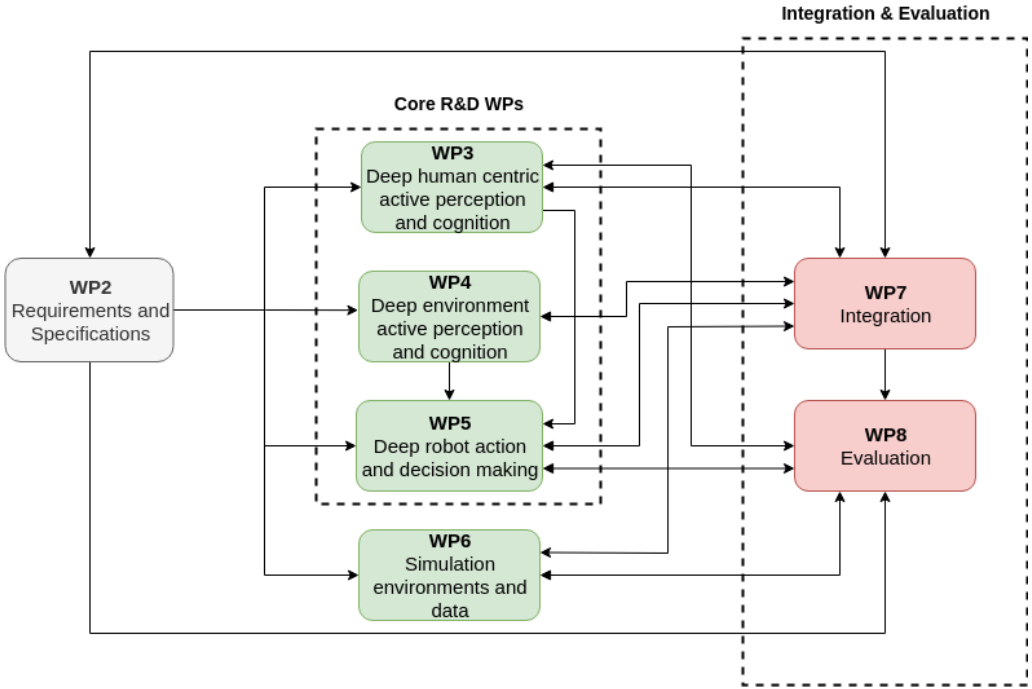
OpenDR workplan



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OpenDR consortium

- **OpenDR** brings together **8 partners** from **7 European countries**
- A **multidisciplinary team** with complementary expertise uniting
  - **Academic institutions** with expertise on
    - *deep learning, computer vision, digital image/video processing and analysis, graphics,*
    - *robotics, control, planning, localization, navigation, as well as production engineering*
  - **Industrial partners** with expertise on developing
    - *robotics simulations*
    - robots for *healthcare* and *agriculture applications*
- Collaboration for the development of a modular, open and non-proprietary toolkit for core robotic functionalities to enhance robotics autonomy

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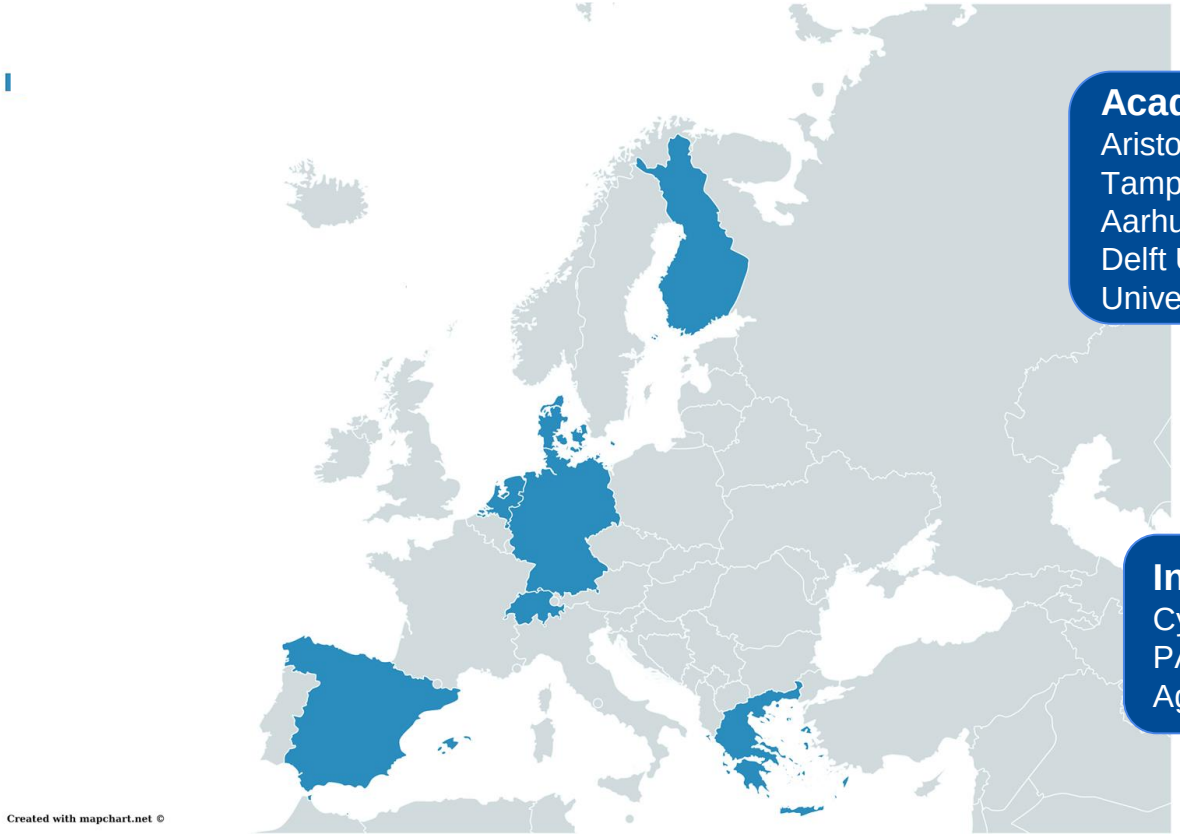

Academic partners:
Aristotle University Thessaloniki (GR)
Tampere University (FN)
Aarhus University (DK)
Delft University of Technology (NL)
University of Freiburg (DE)

Industrial partners:
Cyberbotics (CH)
PAL Robotics (ES)
AgroIntelli (DK)

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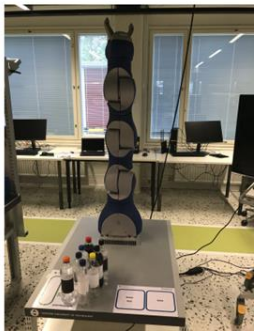
OpenDR Consortium - Infrastructure







Tampere Robolab

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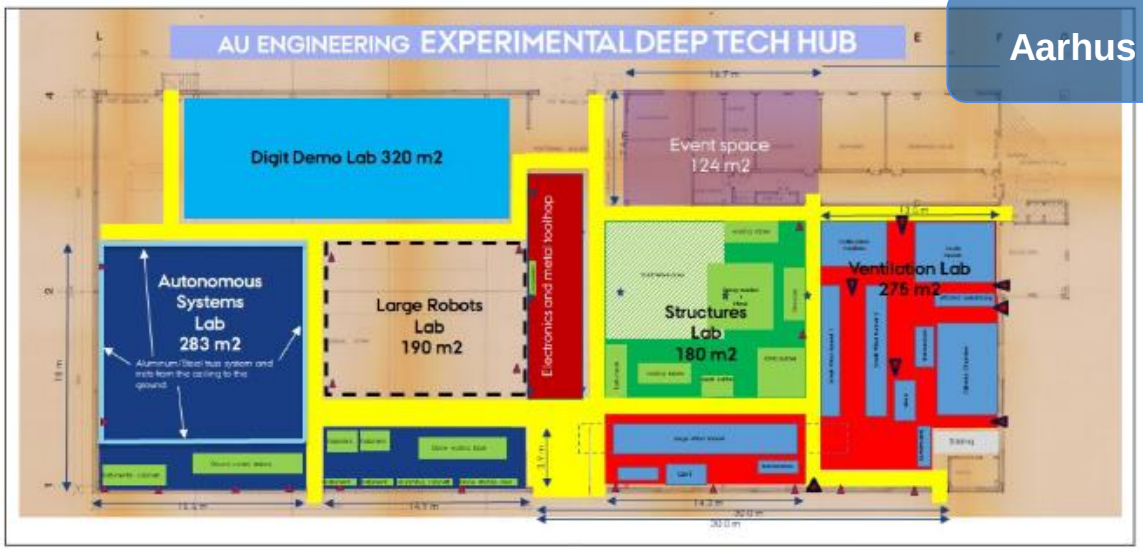
OpenDR Deep Robotics

OpenDR Consortium - Infrastructure



Aarhus Tech Hub

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OpenDR Consortium - Infrastructure

TUDelft Robohouse

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OpenDR Consortium - Infrastructure

PAL Robotics

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OpenDR Consortium - Infrastructure

Agrointelli

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Use-case: Agile Production

Human-robot collaborative Diesel engine assembly

Tampere University

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Deep Robotics

Use-case: Healthcare robotics

Robots supporting elderly people

PAL Robotics

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Open Deep Robotics

Use-case: Agri-food

Intelligent Mechanical Weeding

Agrointelli

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OpenDeep Robotics

Collaboration with Robotics DIH

- OpenDR will co-organize one workshop per year with DIH Trinity
- Establish links to other DIHs networks
- Special focus on the prioritized areas: agri-food, healthcare robotics, agile production, infrastructure inspection
- OpenDR will contribute use-cases to other DIHs

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