



METRICS

Metrological evaluation and testing of robots in international competitions

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Versioning and Contribution History

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1 Objectives

1.1 Context

METRICS is a H2020 project which aims the organization of evaluation campaigns so as to assess the technological maturity of robotic and Artificial Intelligence (AI) systems. The project is coordinated by the French national laboratory for metrology and testing (LNE) in partnership with sixteen European organizations specialized in the evaluation of intelligent systems and in the organization of competitions. Started in 2020, the project will last three years.

The objective of METRICS is to jointly address a twofold challenge:

- Organize challenge-led and industry-relevant competitions in the four Priority Areas (PAs) defined by the European Commission: Inspection and Maintenance (I&M), Agri-Food, and Agile Production;
- Further develop the evaluation methodology to maximize the reproducibility of experiments and the repeatability of performance measurements, to serve as a reference in future competitions.

During the three years of the project, there will be one competition per PA, per year. All the competitions will be designed in a similar spirit: the first year is a dry-run that allows validating the evaluation procedure. After this, a competition will be organized once a year for the two remaining years. Each yearly competition organized during the METRICS challenge includes two types of evaluations:

- A field competition, in which the evaluation takes place in realistic operating environments (physical test-beds);
- A cascade competition that presents a data-based evaluation (data generated during the field competition).

1.2 Purpose of the document

METRICS will address both technical and non-technical challenges faced by robots.

The present document refers to the **ethical, legal, societal and economic aspects** of the use of the different robotic systems. It is a global approach (and specific implementations for each PA) for the acceptability analysis of robots participating in the various METRICS competitions.

In the present methodology, the evaluations will take into account several aspects associated with the use and development of these technologies: ethical (dignity, privacy, non-discrimination, etc.), legal (compliance with safety requirements, etc.), social (public awareness, acceptability, trust, etc.) and economic (estimated cost of operation, added value for industry, etc.).

This document presents the questions that need to be part of the evaluation performed during the campaigns. The way in which the competing teams are interviewed is left to the appreciation

of each competition organizer. We note that for each of the following questions, multiple choices are possible.

The evaluation will be tested and noted through the dry-run and improved. Also, during the dry-run we will be able to assess which of the items should be mandatory (like kill switches, safety of data etc.) and which of them could bring extra points in the assessment of respecting ethical, legal, societal and economic aspects.

2 Evaluation

2.1 Privacy concerns

Assessing access to data collected by the robot - privacy by design features so as to ensure that private information is kept secure and only used appropriately (security breaches)

- Where are all the data collected by the robot saved?
 - Commercial server
 - Secured server
 - Local computer
- How are the data from the robot being used?
 - Analysed anonymized
 - Analysed keeping sensitive data
 - Analysed and then erased
- Is the data collected (by the robots or through other devices) meant to be sold to 3rd parties?
 - Yes
 - No

2.2 Data security in connection to hardware

Assessing the possibility of hacking and remote access to the robot and controlling it. (security breaches)

- Does the robot have cybersecurity protocols?
 - Yes
 - No
- Does the robot use external WiFi?
 - Yes
 - No
- Does the robot connect to other devices or applications through its own WiFi?
 - Yes



- No
- Does the robot have an easily accessible USB port on it?
 - Yes
 - No
- (If the previous answer was Yes) Are there software safeguards to prevent the upload of malicious material on the robot?
 - Yes
 - No

2.3 Emergency access control

Integration of opt-out mechanisms (ex. kill switches) that should be consistent with reasonable design objectives. These questions will highlight if the developers of the robot are aware of the minimal essential safety and health requirements from the Directive on Machinery, that could be an indicator of a certain level of maturity towards market entry.

- Does the robot have a kill switch on it?
 - Yes
 - No
- (If the previous answer was Yes) Is the kill switch easily accessible?
 - Yes
 - No
- Is it possible to regain control of the robot remotely?
 - Yes
 - No
- If there is an external terminal to teleoperate the robot, does it present an emergency stop function?
 - Yes
 - No
- (If the previous answer was Yes) Is this function easily accessible on the terminal, like a specific physical button on the terminal?
 - Yes
 - No
- Does the robot terminal (if it exists) present some other kind of safety functionalities, such as a dead man switch?
 - Yes
 - No

2.4 Physical safety measures

Assessing if the robot is endowed with sensors that can detect and protect humans if they are around OR procedures that stipulates the robot is not to be operated around humans - safeguard the safety and health of those interacting and coming in touch with robotics.

- Can the robot be activated through an “intelligent” detection of the human (such as a voice command, a haptic device, a sensor that detects the proximity of a human, etc.)? This excludes any start command given via a terminal (software or hardware command).
 - Yes
 - No
- Does the robot have a system to avoid obstacles?
 - Yes
 - No
- Does the robot have a system to detect human presence (this means that an obstacle is categorized as a human)?
 - Yes
 - No
- If it detects an obstacle, does the robot engage a specific strategy for the adaptation of its behaviour?
 - Yes
 - No
- Does the robot have an emergency stop procedure if it detects obstacles (general obstacle, or human)?
 - Yes
 - No
- Does the robot have a checklist of safety questions before it starts? (ex.: acoustic or visual message that it will start running, a check that humans have been informed it will go into automatic movement etc)
 - Yes
 - No
- If the robot is running and in autonomous mode (thus likely to choose itself to perform certain actions), does it have mechanisms to alert humans around about this autonomous state (beeps, lights, etc.)?
 - Yes
 - No

2.5 Replacement of human work

Assessing whether the robot is complementing human capacities, not replacing them – robots help humans



- Describe the actions the robot performs that were previously expected by humans
.....
- Does the robot require human intervention to start performing its tasks?
 - Yes
 - No
- Does the robot require human intervention for the analysis of the data collected? (ex: in agriculture, the robot collects data that provides reports BUT final decision is made by humans, based on the reports)
 - Yes
 - No

2.6 Renewable energy

Assessing the use of renewable energy in the use of robots

- Does the robot make use of renewable energy sources? (ex. photovoltaic panels)
 - Yes,
 - No
- Does the development procedure engage “green computing” strategies (such as purchasing environment-friendly components or material, improve algorithmic efficiency, etc.):
 - Yes,
 - No

2.7 Ease of use by final customer

Assessing the user-friendliness of the interface. This helps assess the robot’s level of maturity towards market entry.

- What kind of IT knowledge is required to control the robot?
 - Programming language
 - ROS
 - A GUI (General User Interface)
- At the present stage of development of the robot, if the robot is intended to be used by experts in their applicative field (for example, industrial workers):
 - Will they need any specific intensive training to be able to use the robot?
 - Yes
 - No

- Can the robot be configured by this type of user, or can it only be configured by a trained developer?
 - Yes
 - No

- Is there an instruction manual of the robot?
 - Yes
 - No