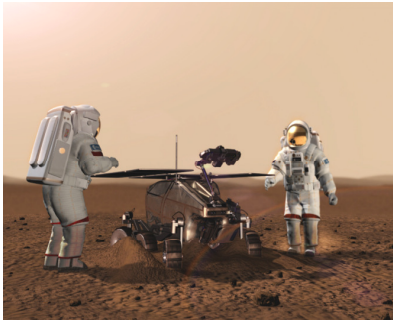# Evaluating Human-Robot Teamwork in a Mixed Reality Environment

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Humans and robots are required to collaborate adaptively in complex environments: human-robot teamwork

Evaluating human robot teams can be difficult, as
• Environment is inaccessible for evaluation
• Costly due to high number of test participants
• Difficult to control the experiment

Many evaluation experiments are possible, differing in:
• The fidelity of the environment and actors, i.e. how well they mimic the real environment
• Whether the environment is fully virtual (as in a serious gaming environment), real world, or partly virtual and partly real

We developed a structured method for choosing and combining different types of evaluation experiments.

## Combining Methods for Adequate Fidelity and Reality

The MECA project aims at developing a distributed crew assistant for manned missions to the Moon and Mars.

To establish a sound requirements baseline and corresponding teamwork-supporting prototype, we conduct:
1. Computer simulations
2. Mixed Reality lab experiments
3. Real life experiments in analogue environments
4. Real life Experiments in an 500 day isolation experiment.
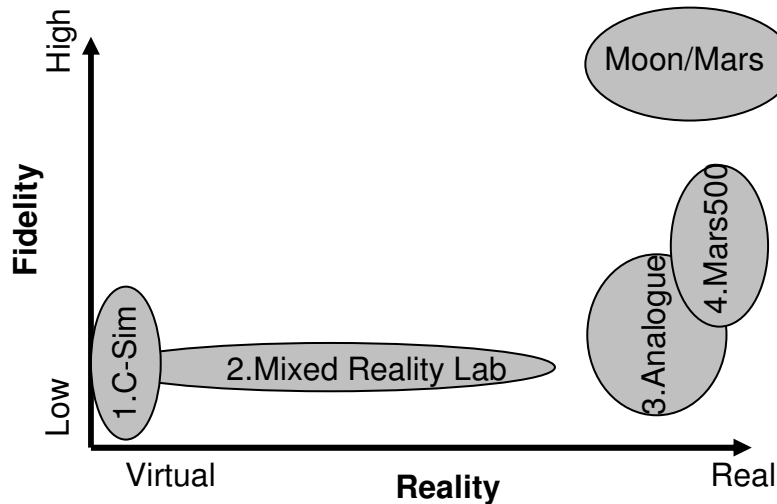


NIFTi aims at establishing effective human robot teamwork for Urban Search and Rescue.

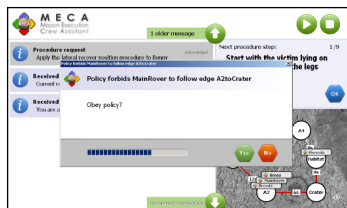As in MECA, we apply mixed reality evaluation techniques to testing our work.

In the first phases, we will perform experiments with simulated robots.

In a later phase of the project, we will perform tests with real robots.

## Empirically Founded Requirements for the Teamwork

### 1. Computer simulation

Using virtual humans and robots we tested the MECA system in a simulated virtual environment.
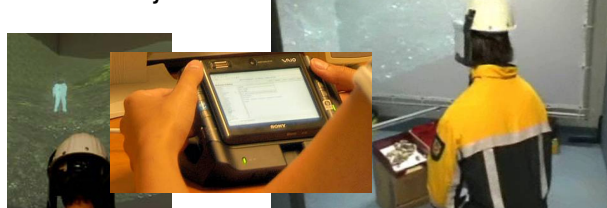
### 2. Mixed reality lab

In our mixed reality lab, we tested MECA with real humans, and in a simulated environment

### 3. Analogue

On volcanic grounds in the Eiffel, we tested MECA using real humans and using real robots

### 4. Mars500

In the Mars 500 project, six test participants are confined in a mockup spaceship for 520 days

We test MECA's capacity to support humans in long-term confinement