The MOONWALK Project
ASTRONAUT-ROBOT COOPERATION DURING SURFACE EVA

ASTRA Conference
Leiden 22/06/2017
The MOONWALK Project

I. COMEX
   – From sea to space

II. The MOONWALK Project
   – simulation of future robotic and manned missions to the Moon and Mars

III. Outlook
COMEX

From the sea to space
COMEX and its expertise

The Compagnie Maritime d’Expertise (COMEX) was founded in 1961 by Henri Germain Delauze (1929-2012).

It became a worldwide pioneer in the development of technologies for human and robotic intervention in extreme environments.
Robotics and Vision – 3D metrology

FONASURF: Subsea mining robotic system

ROV3D / ORUS3D Underwater 3D metrology
Extreme environment engineering

Pressure chamber testing (from vacuum to 400 bar)

Space and stratospheric suits testing and development

Space mission simulation
The MOONWALK Project (FP7)
Simulation of astronaut-robot cooperation during lunar and Martian EVA
The MOONWALK project (European Commission - FP7)

**GOAL**

The goal of project MOONWALK is to develop and test technologies and training procedures for future human missions to Moon and Mars. MOONWALK will focus on astronaut-robot cooperation applied to Extra-Vehicular Activities (EVA) on planetary surfaces.
The MOONWALK project (European Commission - FP7)

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The Simulation Architecture

On site elements

Mission Control Centre at SPACE APPLICATIONS
Comparative cases

Reduced Gravity (1/6th G)

Normal Gravity (1 G)

Astronaut = Astronaut

Astronaut = Robot
Infrastructure during the Rio Tinto tests

- EVA Training Suit GANDOLFI-2
- Robotic Scout YEMO
- Habitat Simulator SHEE
- EVA Information System
- Mission Control
- Sampling tools

Photo: Space Application Services
Infrastructure during the Marseilles tests

- EVA Training Suit GANDOLFI-2
- Robotic Scout YEMO
- COMEX' R/V MINIBEX
- EVA Information System
- Sampling tools
- Mission Control

Photo: Space Application Services
The MOONWALK project

Control of the robot
Gestures, tablet, « follow-me »
The MOONWALK project

Control of the robot
Gestures, tablet, « follow-me »

Biomonitoring
(evaluation of the stress)
The MOONWALK project

Control of the robot
Gestures, tablet, « follow-me »

Biomonitoring (evaluation of the stress)

Hazardous Position Alert
The MOONWALK project

Control of the robot
- Gestures, tablet, « follow-me »

Biomonitoring
- Evaluation of the stress

Hazardous Position Alert

Communication strategies
- Earth-Mars
EVA Information system EVIAS and Sampling Tools
Results:

<table>
<thead>
<tr>
<th>In 1 EVA</th>
<th>Accumulated/peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance: 780m</td>
<td>2200m</td>
</tr>
<tr>
<td>Max distance for 1 EVA</td>
<td>Max cumulative distance for 1 subject</td>
</tr>
<tr>
<td>Time: 00:52:00</td>
<td>04:01:49</td>
</tr>
<tr>
<td>Max time for 1 EVA</td>
<td>Max cumulative time for 1 subject</td>
</tr>
<tr>
<td>Speed: 3.05 km/h</td>
<td>5.1 km/h</td>
</tr>
<tr>
<td>Max average speed</td>
<td>Max speed peak</td>
</tr>
</tbody>
</table>

Current space suit designs might be too heavy for EVA on Mars.

Subsea (or underwater) simulations are a good method for astronaut training while terrestrial simulations serve enormously to test and engineer.
« Today Mars – Tomorrow the Stars! »
Outlook
MOONDIVE: Development of underwater simulations for human missions to the Moon or asteroids (ESA)

Development of methods to train astronauts at the EAC NBF for future missions to the Moon and asteroids.
Thank you!

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