Walking on the Moon: Experiment Design

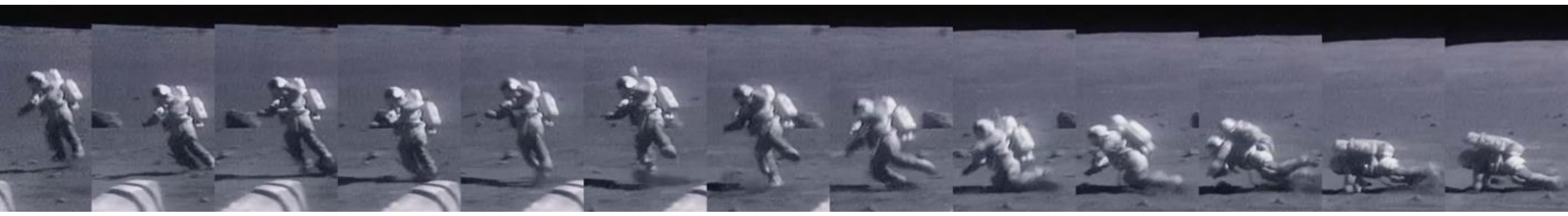


Fig.1 Apollo astronaut tripping (c) NASA (Image elaboration Schlacht & Umhof)

To support the safety and performance of future Moon and Mars habitats (Fig.1), we will investigate anthropometrical and biomechanical data on the walking patterns and balance. This work aims to present the experiment design in order to get feedback from field specialists and achieve a higher quality of the experiment results. The goal of the experiment is to investigate and evaluate two methodologies applied to the measurement of Moon gait on Earth.

Fig.2 The markers position and the Frankfurt plane

One methodology is based on the simulation of weight reduction with the use of water (Fig.3). This methodology will be tested using the swimming pool of the Neutral Buoyancy Facility at the European Astronaut Centre and in the Karlsruhe Institute of Technology. By using a combination of distributed mechanical loads on different parts of a subject's body (and, possibly, floaters to optimize the application point of the resultant force), a realistic reduced gravity effect can be obtained.

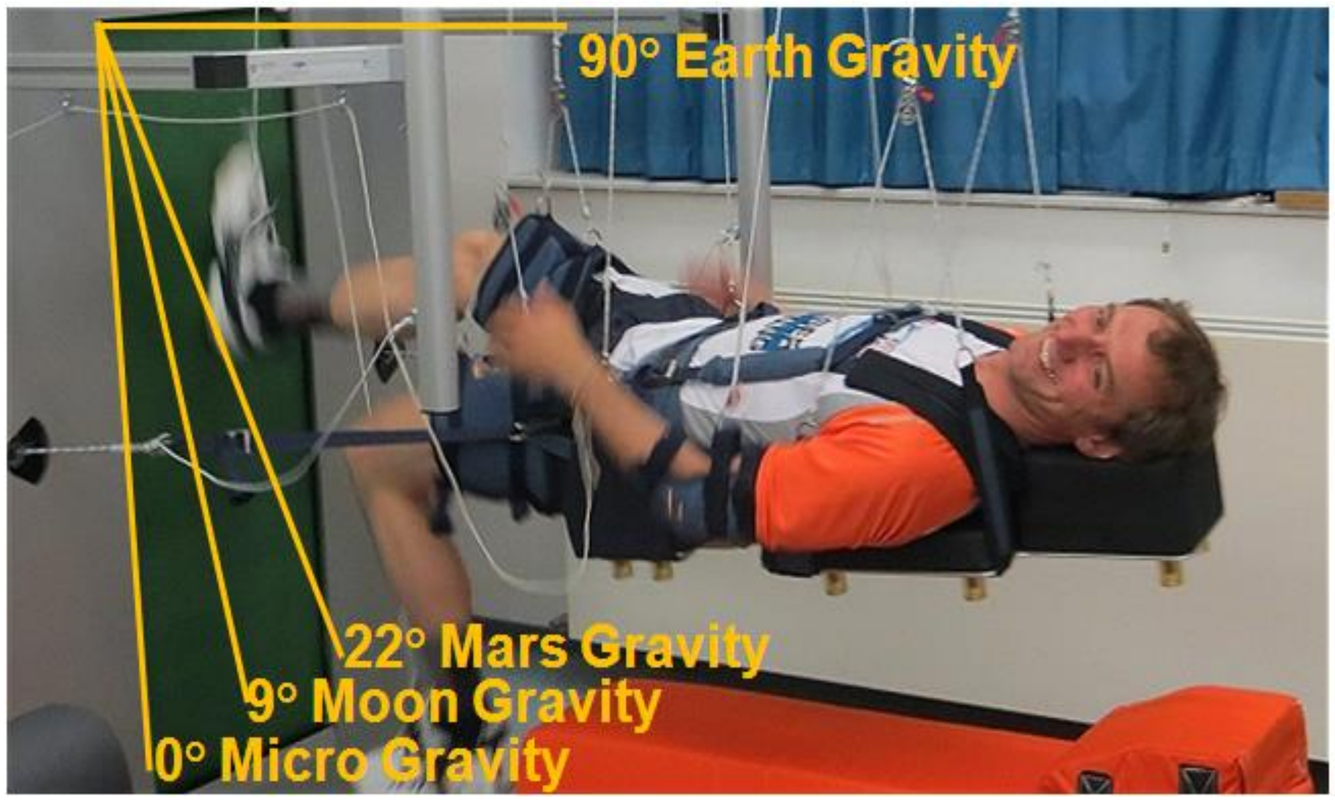
The data will be collected via underwater video recording. The data will be compared with a control study performed outside the water. As a result, the walking patterns will be visualized schematically and with images. Finally, the methodology will be evaluated in terms of whether or not it can be suggested for further study.

Moreover, the methodology will be compared with the same data collected in simulated hypogravity with a modified treadmill (Fig.4). On the modified treadmill, the subject will be held by a wide padded belt, with the upward forces applied to the belt simulating different levels of hypogravity. An accelerometer will be hidden in a belt worn by the subject and the instrument will be connected to a computer measuring speed, step extent, direction of movement, variation of altitude, typology of walk, and balance. A video camera will record the subject's movements and the direction of his line of sight. The markers (Fig.2) positioned on the subject's body will be tracked in the video to derive a model of the walking pattern and the sight line direction.

In conclusion, this research will address, measure, and evaluate two different methodologies for measuring balance and gait during Moon and Mars missions. Furthermore, the research results could be applied to analyze the influence of the gravitational variable on the sensorimotor system and, consequently, to make the data available for the optimization of human safety and performance, for example in future Moon and Mars habitats developed with human-centered design.

Fig.3 Neutral buoyancy walking test

Fig.4 Vertical treadmill (c) Rittweger



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