Paper ID: 60535
student

IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Human Space & Exploration (8)

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ENHANCING HUMAN SYSTEMS INTEGRATION WHILE EXPLORING UNDERWATER, IN A CAVE, 90 METERS BELOW SURFACE.

Abstract

Mission simulations typically focus on the effects of confinement and isolation, or protocol and equipment development. Most of these missions do not simulate manned space missions with high fidelity, and the validity of scientific outcomes obtained from these missions is questionable when related to real manned space missions. For example, low-risk mission simulations are rarely suitable to study decision-making and behaviour in critical operations due to the simulations' predictability. Consequently, it is also questionable to what extent the data describing human factors obtained from one-off, low fidelity and short simulations is reliable and skills acquired from such simulations are transferable and applicable to the real and significantly more complex space missions. Thus we believe more suitable contexts and facilities need to be developed so that the human factors relevant in space exploration can be studied thoroughly. Despite the significant efforts, human factors in extreme contexts remain understudied, and several study outcomes are invalid or unreliable. Human factors continue to be usually mitigated with meticulous sampling and training processes. However, in the not too far future, human space exploration will impose new needs were the human factors may not be "factored out" so easily.

Aquanauta is a series of missions that is to study the adverse effects of isolation, confinement, darkness on cave divers. In our study and facility, a crew of six cave divers, or 'aquanautas' will live in a habitat underground that is connected to a natural thermal cave with a diverse tunnel system completely under water, reaching out nearly 10 kilometers in length to 90 meters deep. Our rationale to organise such high fidelity mission simulations is that astronauts regularly train as divers in large artificial pools, where they can explore the effects of microgravity and practice specific protocols and skills later carried out or used on the International Space Station. Further, astronauts often train together in caves in order to get used to confined and isolated contexts and preparing for missions in the Moon's lava tubes. Our current dive equipment is capable of carrying out approximately seven-hour long dive hikes, similar in length to actual space walks performed by astronauts. Our purpose is to provide valid and reliable research findings over the effects isolation, confinement, darkness and microgravity on humans, and to understand how human factors and the systems we can design can benefit teams in conducting work and/or living in these extreme environments.