

31st IAA SYMPOSIUM ON SPACE AND SOCIETY (E5)  
Space Architecture: Habitats, Habitability, and Bases (1)

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AMBIENT SENSING AND ELICITATION OF HUMAN AFFECTIVE STATES TO COMBAT  
MONOTONY AND BOREDOM IN SPACE

**Abstract**

Major psycho-physiological challenges must be addressed in the design of space habitats for long-duration flights. Psychological health is seriously diminished when humans are in isolated environments for long periods of time; monotony and boredom have been identified as serious stressors that can hinder the growth of space travel. These can be caused by several factors, including low workloads, spatial confinement and limited social interactions due to separation from family and friends. At the same time, without equilibrium, you move between under-stimulation and over-stimulation. The psyche is seriously affected because of reduced sensory variety. Healthy human consciousness, perception and thought can only be maintained in a constantly changing environment. A state of sensory deprivation sets in with the absence of variety in our surroundings, resulting in a negative effect.

Affective Computing Environments (ACE) forms part of a revolution in designing human habitats for long term space flight. The integration of recent developments in the field of affective computing within environmental design will make it possible to create habitats with the ability to perceive and elicit human emotion states for well-being. By connecting emotion sensing software with kinetic architecture, ACE responds to the facial expressions of occupants through motion and colour. By interacting with human emotions, ACE can appear more empathetic and provide a more natural user interface for autonomous technology than traditional human-designed environments.

The design of ACE that could leverage ML to constantly monitor, evaluate and adapt to the emotional state of crew and passengers of future human space exploration will be essential to guarantee the success of future missions. Several ML based automated means of passive observation systems are emerging today with the goal to evaluate the psychological health of people. However on long-duration missions and with no real-time communication with mission control and specialists, evaluation alone will not be enough, in case of serious psychological health deterioration is detected, there will be the need for intervention as well. The latter could be implemented through the development of environments and objects that could provide needed sensory stimulation in relation to the negative accumulated emotional states.

In this paper, we present the conceptual framework for ACE based on ‘Affective-Loop’ theory. The framework is illustrated through a design case study. It demonstrates how ACE facilitates cooperative behavior with occupants. The closing section considers reflects on how treating affective systems at the environmental level enables new application domains in the aerospace industry.