HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
Astronauts: Those Who Make It Happen (5)

Author: Dr. Li Hao
China Astronaut Research and Training Center, China

AGENT-BASED MODELING AND SIMULATION OF ASTRONAUTS' BEHAVIORS DURING LONG-DURATION SPACE FLIGHT

Abstract

With support of large space platforms, such as the Internal Space Station, the astronauts will stay in space for a longer period, which means that we will have more chance to perform complex space experiments and difficult operational tasks. However, the space context is not suit for human beings staying long time, many behavioral issue associated with long-duration space expeditions, such as work, outside communications, adjustment, group interaction, recreation/leisure, equipment, event, organization/management, sleep, food, logistics/storage, exercise, procedures/rituals, leadership, and medical, will affect crews heavily, so countermeasures must be taken to ensure crews healthy and safe. Furthermore, crews are often assigned more works than that usual complete on the ground for more yielding, so study must be carried out before long-duration space flight in order to make crews more effective. Unfortunately, it is infeasible to create the same physical environment as that during space flight temporally and spatially, and the physical simulator has inherent limitations, even today it cannot recreate the same microgravity environment for a long time as that in space yet, and differences between operations in space and on the ground will shade some important information, therefore computer simulation is often one of the promising technologies for long-duration space flight studying. Agent-Based Modeling and Simulation (ABMS) is a good choice to study astronauts' behaviors during long-duration space flight, which offers a framework to model space flight system including crews, vehicle, equipment, and so on, and provides many approaches to be used for crews' behaviors modeling. In ABMS, each astronaut is represented as an agent, which integrates physical and mental characters in one framework. On one hand, an agent can learn from its context by practice and update its knowledge to upgrade itself, on the other hand, it has ability to interact with other agents and objects in the system and the environment for more information. And by using the multi-layer architecture and the aggregation method, we can analyze the whole system in detail without representing too many objects in one time. By using ABMS, we can set the main principles of crews before simulation, and the running the simulation to yield some information that we can neither get by physical experiments on the ground nor calculate by using traditional mathematical equations. This information will direct us to make good schedules for crews during long-duration space flight, and avoid bad decision-making for important manned space flight missions.