

Challenges of Life Support/Medical Support for Human Missions (8)
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SYMBIOTIC SELF-MOVING MESSAGE ROBOT "TRIANGLE": CONCEPT AND PROSPECTS OF
USE ON BOARD PILOTED SPACE STATION

Abstract

For back and chest massage, sliding cupping massage (SCM) is widely used, combining influences from vacuum cuppings (VC) and massage. Simplicity and efficiency of SCM make it attractive for use on board Space Station (SS). However, following problems occur: • Impossibility of conducting SCM without participation of second astronaut. • For duration of SCM, two crew members will be distracted from performing planned work. New symbiotic approach to organization of SCM on board SS is proposed with help of autonomous self-moving parallel massage robot "Triangle" with 3 DOF (degrees of freedom). Essence of symbiotic approach is to combine "Triangle" with astronaut's body into single whole and ensure their independent functioning during SCM. Thanks to symbiotic approach, astronaut can carry out planned work, as well as fulfill physiological needs during SCM. "Triangle" is made in form of triangular rod mechanism of parallel structure with VC at its vertices. Such structure provides "Triangle" with geometric immutability and work of rods only for tension/compression and, as result high rigidity and low specific gravity. Each of rods of "Triangle" is equipped with linear drive with force, relative displacement and relative speed sensors. VC is hermetically connected by flexible hoses to corresponding channels of air distributor, which is equipped with pressure sensors and vacuum pump. Control system of "Triangle" provides operational control and management of SCM in real time. Before start of SCM, astronaut applies "Triangle" to surface of body and fixes it by vacuuming VC. After their fixation with body of astronaut, symbiosis "astronaut - "Triangle"" is formed, symbionts of which can continue to function independently of each other. At same time, it should be noted that symbiosis obtained on board SS is preserved regardless of movements of astronaut and his spatial orientation. Proposed symbiotic approach will allow automating processes of SCM of astronaut's back and chest on board SS. At same time, astronauts can perform scheduled work during SCM, which makes it possible to eliminate their non-productive loss of time for SCM. If necessary, on-line communication between professional masseur of ground service and symbiosis "astronaut - "Triangle"" can be organized via Internet. To expand functionality, ultrasonic and other sensors can be installed at vertices of "Triangle". In future, "Triangle" can be used to serve participants of long-term Moon and Mars expeditions. To determine kinematic and dynamic parameters of "Triangle", full-scale pneumatic prototype was manufactured and tested at IMASH RAN.