IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IP)

Author: Dr. You LI
Astronaut Research and Training Center of China, China

Prof. Chunhui WANG
Astronaut Research and Training Center of China, China
Ms. Qu YAN
Astronaut Research and Training Center of China, China
Dr. Liang XIE
National University of Defense Technology, China

SPACEMOTION: COMPUTER VISION ASTRONAUT MOTION CAPTURE SYSTEM

Abstract

Purpose To achieve the harmony of human-machine-environment system is the goals of human factors engineering. For long-term manned flights, getting the astronaut's pose, kinematics, and behavior data, analyzing the interaction between the astronaut and the capsule, equipment and other astronauts is an important part of the research on aerospace human factors engineering. **Methodology** In this paper, a computer vision system composed of multiple RGB-D cameras is proposed to capture the motion of astronauts in orbit. During the ground preparation phase, the 17-joint human body model was scanned with DynamicFusion and the internal parameters of the color cameras were calibrated separately. In-orbit acquisition phase, 3 or 4 cameras arranged in the cabin corner, simultaneous acquisition of astronaut's neutral pose, free movement, maintenance operations and other video. In the ground processing stage, the external parameters of each color camera are calibrated by marking points, and then the point clouds from each camera are fused by ICP method. The pre-trained depth neural network is used to detect the position of the human joints, and then the pose is initialized. Then, the pose is refined through an improved ICP method. During the pose tracking process, the user can observe the overlap result in 3D space/color image/depth image and the match value. The user can manually adjust the pose tracking result. **Results** The system was launched with TG-2 and applied to SZ-11 experiments. It processed the mission video of two astronauts and captured the astronaut's pose, occupancy space, and kinematics data successfully. For the first time, we obtained the in-orbit neutral pose and the height curve. The error of the joint position is within 5 mm and the angle error is within 2.5 degrees, which are mainly due to the accuracy and resolution of depth camera. **Conclusions** SpaceMotion is the world's first space computer vision motion capture system. It's small and lightweight, has the advantages of non-contact measurement, intuitive, high-precision, and has no need to paste any mark on the human body. In-orbit experiment results show that it is fully suitable for micro-gravity, small space environment. SpaceMotion measures astronaut's pose, space occupancy, kinematics data, which are important for aerospace human factors engineering. In the future, we will select higher performance RGB-D cameras; improve the algorithm so that it will continue to play an important role in subsequent tasks.