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THE ANALYSIS OF THE RELATIONSHIP BETWEEN MOTION RESTRAINTS CAUSED BY PRESSURIZED SUITS AND RISK OF FALLING

Abstract

Locomotion of astronauts on a planetary surface has strong relationship to the performance of spacesuits. This is because previous spacesuits potentially interferes a motion of the astronaut and this restraint will occur many hazards. On the ground, falling is the most important risk because it sometimes causes severe injuries. Although the shock of falling decreases on the planetary surface because of low gravity, contact with environmental object is serious risk factor. Therefore, this study focuses on the risk of falling of the astronaut. At first, to simulate the motion restraint of spacesuits, a brace was developed. This brace can apply torque to each joint of lower limb using DC motor. The restraint pattern is based on the Perisach hysteresis model and experimental data of previous spacesuits. In addition to the brace, protectors, supporters and safety harness were used for the safety of subject. In our experiment, a subject with the brace and safety devices walk through the measurement field and the change of gait patterns are analyzed using motion capture system and force plate. In some cases, subject is tripped from outside and the change of motion to avoid falling is measured. To analyze the motion, in addition to general gait parameters such as speed, step length and stance ratio, gait parameters such as moments of lower limb joints, maximum distance between ground and the bottom of the foot and movement of ZMP are calculated. As a result of the experiment, the range of joint angle of subject decreased in some cases. Because of the restraint of joint flexion gait motion became more compact. However, some subject changed their gait to slow and long stride. In these cases, range of hip joint increased. Using the hip joint instead of the knee joint is effective against the joint restraint because the torque of hip joint is larger than that of knee joint. These tendencies are related to the risk of falling because step height and step time is important to prevent sudden tripping. In this study, low gravity is not simulated because this study aims to analyze the effect of joint restraint. However, simulation of gravity will be needed to simulate accurate motion on the planetary surface.