DESIGN OF EXOSKELETON FOR MUSCULOSKELETAL SUPPORT OF HUMAN BODY UNDER LOW GRAVITY CONDITIONS AND ITS PERFORMANCE EVALUATION BY FLUID DYNAMIC ANALYSIS

Lavanith Togaru, Karthik Naganathan
Department of Mechanical Engineering, Kakatiya Institute of Technology & Science: Warangal, Telangana, India.

ABSTRACT

The human body has evolved and adapted to the environmental conditions it lives in. Any drastic changes in these conditions may affect its normal functioning. This makes space travel a potential hazard to the astronauts due to its harsh environment. To achieve a safe travel in either long commute to a planet or a short trip to ISS and the moon, the environmental conditions have to be controlled. The cabin of spacecraft and the spacesuit are designed to control the temperature and pressure according to the requirements of the astronauts. But problems arise due to the prevailing low-gravity and microgravity conditions in space.

Compared to other issues, the loss of bone mineral density, hydrostatic pressure reduction, and orthostatic hypotension are badly affecting the astronauts from the past. Although there are some curative adoptions, many of them are not quite effective. This paper summarizes the use of a specially designed exoskeleton for the human body which can be used in space travel to lower some of the health risks which arise due to change in gravity.

The exoskeleton was designed considering different joints and their Range of Motions (ROM) to support normal functional movements of the body in space. It covers from shoulders to foot which contains fluid-carrying tubes embedded into it. These fluid lines and different bio-mimicked joints form as functional elements in the exoskeleton. Fluid dynamic analysis is used to evaluate the nature of fluid flow and to check its biomechanical performance. The results obtained are used to investigate its biological and medical relevance in the areas of musculoskeletal and cardiovascular systems. In view of the complexity in the fabrication of embedded fluid lines, this design was made compatible with additive manufacturing for ease of fabrication.