NASA SBIR/STTR Technologies

X11.01: Crew Exercise System

ESPRIT: Exercise Sensing and Pose Recovery Inference Tool

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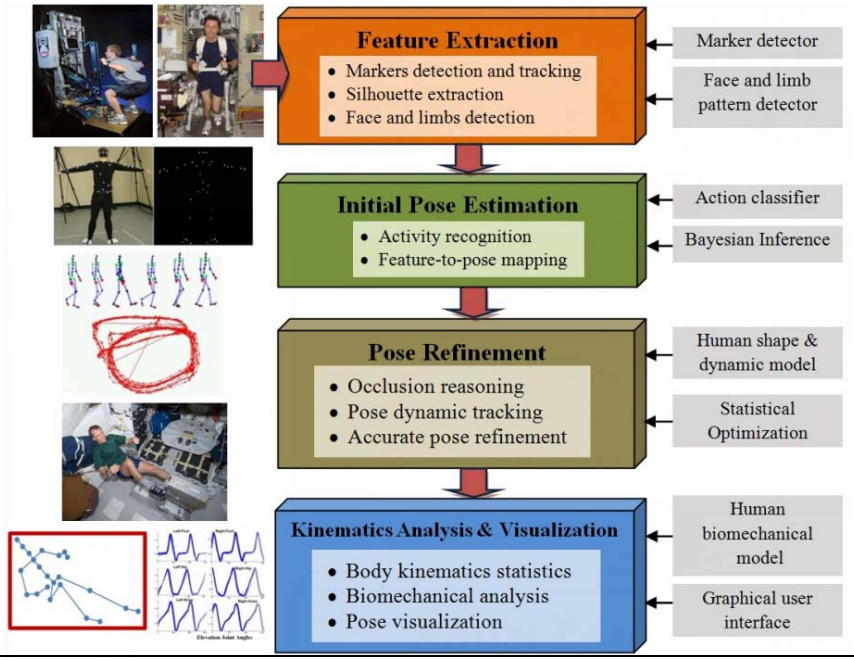
Identification and Significance of Innovation

Crew exercise is important for maintaining the health and fitness of astronauts, especially in preventing adverse health problems associated with long-duration space flight, such as losses in muscle strength and endurance, bone density, balance and aerobic capacity. These adverse effects could degrade their performance during space missions.

We propose to develop **ESPRIT: an Exercise Sensing and Pose Recovery Inference Tool**, in support of NASA's effort in developing crew exercise technologies for astronaut health and fitness. ESPRIT is a single camera system that monitors the exercise activities of the crew, detects markers placed on the body and other image features, recovers 3D kinematic information of the human body pose, and compiles statistical data about the exercise activities. There are two main challenges for motion capture using a single camera: (1) lack of depth information, and (2) partial occlusion of parts of the body. To overcome these challenges, the proposed framework relies on strong priors on human body pose, shape, and motion dynamics to resolve pose ambiguities. Besides marker locations, it extracts other image features that provide additional cues for recovering pose. It combines both discriminative and generative approaches to achieve robust pose estimation and tracking performance.



Estimated TRL (1 – 9) at beginning and end of contract:

Beginning of Contract: TRL level 2, End of Contract : TRL level 4 (Phase 1)

Technical Objectives and Work Plan

IAI will demonstrate the feasibility of **ESPRIT** to provide motion capture capabilities for crew exercise monitoring. Phase I technical objectives are:

Objective 1: Software and hardware architecture design of ESPRIT. We will define system requirements, use case scenarios, desired capabilities, performance measures.

Objective 2: Knowledge models for human anthropometry, pose and dynamics as prior models for pose estimation. We will develop statistical models for achieving robust 3D pose estimation

Objective 3: Robust human pose estimation. We will develop algorithms to detect and track worn markers and other image features, and recover 3D kinematic poses.

Objective 4: Demonstration of the feasibility of ESPRIT. A prototype system will be developed and performance evaluation will be conducted.

NASA and Non-NASA Applications

Potential NASA Commercial applications

ESPRIT system will support NASA's Exercise Countermeasure Project for observing crew's exercise activities, performing 3D motion capture and kinematic analysis.

Potential Non-NASA Commercial applications

Non-NASA applications include uses in medicine and rehabilitation, such as gait analysis, orthopedics, and other applications for monitoring skeletal movement. Other applications include simulation, immersive reality, video games, personal fitness, human-robotics and human-computer interaction.

Firm Contacts

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