AERONAUTICAL AND ASTRONAUTICAL ENGINEER

DESIGN AND BUILD OF EVA COMPATIBLE, BOLT/MOTOR BRACKET ASSEMBLIES FOR THE R-SLC SYSTEM AND ANALYSIS FOR FOLLOW-ON REDUCED GRAVITY TESTING

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The Robotic-Sidewall Logistics Carrier (R-SLC) is a design solution for putting small payloads (military and non-military) on orbit while meeting the requirement to transfer experiment and logistics equipment between the Space Shuttle and the International Space Station (ISS) by robotics rather than through the conduct of extra vehicular activities (EVA). The concept, design, and fabrication were all conducted by students and faculty at the Naval Postgraduate School (NPS) and the Boeing Defense and Space Group (Boeing).

Using as much off-the-shelf technology as practical for the design, the R-SLC will provide a lightweight, stand-alone means to more cost effectively carry small payloads aloft in the Shuttle cargo bay. This hardware will be fully Remote Manipulator System (RMS) compatible for on orbit removal and retrieval operations. Transferring or deploying payloads via the RMS reduces the requirement for astronauts to conduct EVA operations. EVA operations will only be required where system failure of power or robotics occurs.

This thesis project, specifically the bolt/motor bracket assemblies of the R-SLC, will integrate some off-the-shelf parts with three primary hardware elements specifically designed for this assembly. This innovation will provide the means to attach an EXPRESS pallet adapter to a side wall carrier so that it is removable and replaceable during EVA contingency operations. Special considerations were given to human factors engineering during the design process in order to accommodate the suited astronaut in a zero-gravity environment. Part two of this thesis encompasses the hazard and structural analyses of specifically designed flight support equipment and planning for a reduced gravity flight test aboard the NASA KC-135A aircraft in order to validate EVA compatibility.

DoD KEY TECHNOLOGY AREA: Other (Manned Space Flight)

KEYWORDS: Orbiter, Robotics, Logistics, Space Shuttle, ISS

ACOUSTICAL EMISSION SOURCE LOCATION IN THIN RODS THROUGH WAVELET DETAIL CROSS CORRELATION

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Flaws in structural elements release strain energy in the form of stress waves that can be detected through acoustical emission techniques. The transient nature of a stress wave is analytically inconsistent to Fourier Transforms, and the wave

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characteristics under the effects of dispersion and attenuation deviate from the formal basis of the Windowed Fourier Transform. The transient solid body elastic waves contain multiple wave types and frequency components which lend themselves to the time and frequency characteristics of Wavelet Analysis. Software implementation now enables the exploration of the Wavelet Transform to identify the time of arrival of stress wave signals for source location in homogeneous and composite materials. This investigation quantifies the accuracy and resolution of two existing source location methods and develops a third technique using the Discrete Wavelet Transform on a windowed portion of the stress wave signal. A refined method for the spatial location of material damage induced stress waves can be used to directly monitor the safe-life of structures and provide a quantitative measure for the risk assessment of critical and aging structures.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Space Vehicles, Materials, Processes, and Structures

KEYWORDS: Acoustical Emission, Composites, Structures, Wavelet Analysis