

SPACE SYSTEMS SYMPOSIUM (D1)
Poster Session (P)

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A SPF IDENTIFICATION METHODOLOGY FOR TVC SYSTEMS IN LAUNCH VEHICLES

Abstract

A single point failure (SPF) identification methodology for thrust vector control (TVC) systems in launch vehicles is introduced, its application demonstrated. A TVC system is usually complex and may have thousands of parts which are wrapped in layers of devices or components. A complete set of its SPF modes is hard to identify, leading to blind zones in quality control of even some old systems, and what's the most unacceptable, sometimes a failure of an inconspicuous bolt or seal but in fact critical to mission success. The new methodology is based upon a logic decomposition and classification of the system and then a logic identification of SPF in layers of reliability block diagrams. In top layer, a typical TVC system is decomposed to 3 circuits in series, namely, hydraulic power, servo control, and motion. Each circuit is further decomposed to 4 kinds of sub circuits in series, namely, basic function, mechanical link, electrical connection, and seals. In each sub circuit, the reliability block diagram is plotted and SPFs are identified in that circuit. Since all circuits are in series in reliability logic, a complete set of SPF modes could be easily demonstrated, especially for some bolts, cables, connectors, and seals which are often dealt with in batches before but whose failure effects could be easily ignored. The methodology has been applied in Chinese manned space missions and is also instructive for both rookie and veteran engineers.