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INTEGRATED SAFETY FRAMEWORK FOR AUTONOMOUS SPACECRAFT: A COMPREHENSIVE APPROACH TO RISK ASSESSMENT, DECISION-MAKING, AND AUTOMATED RESPONSES

Abstract

In order to ensure the safety and risk management of autonomous spacecraft operations, the project intends to tackle the ever-changing obstacles that arise in this domain. Aiming to establish a resilient system that integrates sophisticated risk assessment methodologies, intelligent decision-making algorithms, and automated responses to promptly mitigate potential hazards, the proposed framework is motivated by the growing intricacy and autonomy of space missions. A comprehensive analysis of current safety protocols in autonomous spacecraft operations is the initial step of the study, which identifies deficiencies and constraints in existing methods. By leveraging knowledge gained from human factors research, machine learning, and space mission data, this endeavor seeks to develop a novel framework that can dynamically adjust to unforeseen conditions. By doing so, it hopes to enhance the overall safety profile of autonomous spacecraft. The integrated safety framework comprises sophisticated risk assessment models that analyze historical mission data, forecast potential hazards, and quantify associated risks using machine learning algorithms. The development of decision-making algorithms will involve the consideration of external environmental conditions, mission objectives, and spacecraft capabilities when assessing risk scenarios in real time. In addition, automated response mechanisms will be incorporated into the framework, enabling the spacecraft to implement predetermined safety protocols or modify its operations in order to mitigate identified risks. To ascertain the efficacy of the proposed framework, a series of simulated scenarios and case studies will be undertaken, encompassing an extensive array of potential hazards and emergency circumstances. The outcomes will be evaluated in order to ascertain the framework's capacity to evaluate risks with precision, generate well-informed judgments, and execute automated reactions promptly and efficiently. Anticipated outcomes of this investigation include the development of a novel and adaptable safety framework applicable to a vast array of autonomous spacecraft missions. Through the seamless integration of risk assessment, decision-making, and automated responses, it is anticipated that the framework will substantially enhance the safety and dependability of forthcoming space missions. This, in turn, will promote the progress of autonomous space exploration and guarantee the sustained advancement of space activities.