23rd IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 23rd IAA SYMPOSIUM ON SPACE DEBRIS (IP)

Author: Ms. Rommina Terreros
Universidad Nacional Mayor de San Marcos, Peru

Ms. Yesenia Torres
Universidad Nacional Mayor de San Marcos, Peru
Mr. Romildo Genaro Silva Cuadros
Universidad Nacional Mayor de San Marcos, Peru
Mr. Cristhian Daniel Saico Merma
Universidad Nacional Mayor de San Marcos, Peru
Ms. Jhina Antonia Mucha Mateo
Universidad Nacional del Centro del Peru, Peru
Prof. Avid Roman-Gonzalez
Asociacion Civil Universidad de Ciencias y Humanidades, Peru

HYBRID CNN AND RNN APPROACH FOR SPACE DEBRIS DETECTION AND CLASSIFICATION

Abstract

The increase in satellites and space missions has led to a significant increase in space debris in orbit, posing risks to the safety and sustainability of space operations. Traditional detection methods, based on ground-based radars and telescopes, present limitations in terms of accuracy, coverage and are of high cost, making effective detection and monitoring difficult. Our goal is to develop an innovative machine learning based tool for detection and classification of space debris from satellite images by integrating convolutional neural networks (CNN) and recurrent neural networks (RNN). Where the CNN architecture extracts relevant spatial features, while the RNN captures temporal and sequential patterns, improving the identification and tracking of moving objects. The evaluation of the model is carried out using metrics such as accuracy, recall, F1-score and inference time, ensuring its operational feasibility. To train and validate the model, the Space Debris: The Origin dataset of the European Space Agency (ESA), which provides information on space debris orbital elements and their origin, is used. The proposed model is expected to outperform traditional methods and to significantly improve accurate and rapid classification in space debris identification, which would contribute to collision risk reduction and strengthening mitigation strategies. This study contributes to the preservation of orbital space and the development of more efficient technologies for space debris monitoring and management, promoting the safety and sustainability of the space environment.