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A STUDY ON MACHINE LEARNING AND NATURAL LANGUAGE PROCESSING TECHNIQUES FOR THEOS-2 SMALLSAT FAULT ANALYSIS

Abstract

Nowadays, Machine Learning (ML) and Artificial Intelligence (AI) techniques are widely used and solved in several problems and significantly reduced human resource and human error in many cases. The space exploration and satellite industry are increasingly being popularity and payload becomes integrating with a lot of various sensors. The reason is that causes the complexity of formulation of the massive data. Thus, ML and AI are proceeding to provide the solution and the technological domains are being applied for examples On-flight experiment (Smart and Autonomous Satellite), Ground segment support systems (Telemetry data clustering and classification), and Intelligent application platform (Intelligent Image and Video Processing techniques for Smart Geo-data prediction). For the application of Thailand space technology, the ML and AI techniques are planned to gradually apply and use from ground segment in 1st phase after launched of THEOS-2 SmallSAT project. THEOS-2 SmallSAT is being developed and associated between SSTL and GISTDA engineers for the mission of earth observation over low earth orbit including optical, AIS/ADS-B and experimental Raspberry Pi payloads. The paper is going to figure out the experiment of the study on the realistic scenarios from previous mission of SSTL and prioritizing the critical subsystem e.g. life time and performance degradation such as power system and AOCS system. The method of the massive housekeeping data classification is the Bidirectional Long Short-Term Memory of deep learning method with word embedding from Natural Language Processing (NLP). Then, the classified data will be proceeded into spacecraft fault diagnosis process based on Fault Detection, Isolation Recovery (FDIR) of the individually experimental mission. In addition, the fault prediction is proposed trade-off the solution between Support Vector Machine (SVM) and some techniques are being studied. As a result, the study from previous mission will be traded off to match with characteristics of the THEOS-2 SmallSAT based on FDIR and relevant information to justify which solution is proper for the satellite and then formulating a plan and implementation on the ground segment afterward.