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TAXONOMY FOR RESIDENT SPACE OBJECTS IN LEO

Abstract

The increasing number of resident space objects (RSOs) has raised concerns about the risk of collisions and catastrophic incidents for all direct and indirect users of space. To mitigate this issue, it is essential to have a good understanding of the various RSOs in orbit and their behaviour. A well-established taxonomy defining the several classes of RSOs is a critical step in achieving this understanding. This taxonomy helps assign objects to specific categories based on their main characteristics, leading to better tracking services. Furthermore, a well-established taxonomy can facilitate research and analysis processes by providing a common language and framework for better understanding the factors that influence RSO behaviour in space. These factors, in turn, help design more efficient and effective strategies for space traffic management. Our work proposes a new taxonomy for RSOs focusing on the low Earth orbit regime to enhance space traffic management. In addition, we present a deep learning-based model that uses an autoencoder architecture to reduce the features representing the characteristics of the RSOs. The autoencoder generates a lower-dimensional space representation that is then explored using techniques such as Uniform Manifold Approximation and Projection to identify fundamental clusters of RSOs based on their unique characteristics. This approach captures the complex and non-linear relationships between the features and the RSOs' classes identified. Our proposed taxonomy and model offer a significant contribution to the ongoing efforts to mitigate the overall risks posed by the increasing number of RSOs in orbit.