Informative optimal collision avoidance manoeuvrers using deep learning

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Active collision avoidance is an effective method to protect satellites from probable collisions with other resident space objects. Because fuel is critical for the mission, the collision avoidance maneuver should not only avoid a collision but also do it with using minimal fuel. However, it is a compute-intensive task to compute suboptimal collision avoidance maneuvers. Therefore, a surrogate model to calculate optimal collision avoidance maneuvers is essential to improve the efficiency and reduce the complexity of space operations. In addition, a machine learning model that can map collision summary message to informative optimal maneuver decisions for thousands of objects in near-real-time is important for space traffic management. The author showed the feasibility of such machine learning model by developing a gradient boosting tree structure which is one of the best machine learning methods for structured data. However, XGBoost, a gradient boosting tree algorithm, requires all data present at the beginning of the training due to the underlying theory. In this paper, the author will investigate the different deep learning architectures to develop a robust machine learning model that can be generalized for all objects in space catalog. Moreover, the developed model can be improved with the new data due to the versatility of neural network architectures. The training data will be created from the orbital information of objects in the official space catalog. The training data will be separated into training data, development test, and test data to show the generalization capability of the developed machine learning model.