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Title

Field reconstruction of the spacecraft from limited sensors based on graph neural networks.

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Abstract

With the development of space technology, how to realize the real-time and high-accuracy prediction of the spacecraft's physical field plays an important role on intelligent control and status detection. Traditionally, this is achieved by some sensors at the key location. However, the sensors provide limited information of the spacecraft. Thus, reconstructing the physical field can greatly improve the status detection of the spacecraft. Moreover, for the subsystems within a spacecraft's close relationships, we have proposed the field reconstruction of the spacecraft based on graph neural networks. Firstly, we model the subsystems of a spacecraft into a mathematical graph and embed the relationships between the subsystems and the monitoring sensors by the edges of the graph. Then we construct a graph neural network to extract the hidden features of the limited sensors through an encoder and obtain the whole physical field of the spacecraft via a decoder. As one of the deep learning models, the graph neural network can provide a real-time prediction of the field and the embedding of the relationships within the spacecraft could help improve the precision of the final prediction. By this graph neural networks, we have realized the real-time and high-precision reconstruction of the whole field, which can help the intelligent control and status detection of a spacecraft.