Paper ID: 70056
student

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Interactive Presentations - IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (IP)

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REINFORCEMENT LEARNING AIDED PATH PLANNING ALGORITHM FOR MULTI-UAV BASED IN-SITU SATELLITE TERMINAL ANTENNA EVALUATION SYSTEM

Abstract

Along with the growth of the satellite communication industry, the requirement to validate the performance of the terminal antennas is increasing to secure the communication. In this context, an antenna under the test (AUT) evaluation process needs to be changed. Unlike the use of conventional test facilities which is time consuming and expensive, antenna testing is required to be more accessible for anybody, anywhere. In our project so far, an Unmanned Aerial Vehicle (UAV) system has been developed to make the in-situ antenna evaluation possible. This UAV based antenna testing system has Radio Frequency payload and can collect signal strength in the operation frequency of AUTs. As a part of the development of this test system in this paper, we develop a path planning algorithm for area exploration with multiple UAVs, which can dynamically guide the UAVs online. This developed algorithm can help the antenna evaluation process to be more reliable and faster in several stages of the evaluation. For example, before executing the antenna evaluation, the test-site needs to be evaluated in order to perform valid evaluations by ensuring there exists no interfering signals in the area. Also, another aspect for this algorithm to be effective is radiation pattern measurement. Although flight path to cover the area can be calculated offline and programmed before initiating flights, UAVs can experience disturbances during the measurement such as a gust and then, the density of the measurement points may be no longer uniform. Hence, it is beneficial to have an online path planning algorithm to guide UAVs which can generate efficient cooperative flight path. We will present path-planning algorithm by using deep reinforcement learning technique. The algorithm generates the actions for all UAVs in the continuous action space. Unlike the typical graph-based path-planning algorithm, we consider an image of a certainty map of the area as an input of the system. This certainty map is generated based on the calculation of entropic information i and the task is terminated when this entropic information is above a defined threshold on all over the area. In this way, this algorithm can allow the system to generate more flexible flight path and ensure all the area is explored to meet with this threshold when the exploration is finished. The effectiveness and evaluation of the proposed algorithm are discussed with simulated test scenarios by comparing with other several possible approaches.