Benchmarking Autonomous Robotics Controllers

Benchmarks processes are established in all engineering areas, from consumer electronics manufacturing to satellite building. The objective is to evaluate a system under different conditions, assessing the performance and tolerance of different parameters in order to ensure the quality and functionality of the product. For instance, a satellite has to support extreme vibrations while its electronic has to support high radiation doses. In any case, these parameters are well-defined and can be objectively measured through experiments. However, such analysis for autonomous robotics that integrate Artificial Intelligence (AI) Planning & Scheduling (P&S) techniques for on-board planning (i.e., E4 autonomy) is an open issue. In the literature, autonomous controllers are assessed from a coarse granularity, while relevant aspects about autonomy remains unclear. For instance, it is hard to analyze how different environmental conditions affects the controller performance and its autonomy, or its tolerance to the inherent uncertainty when dealing with challenging scenarios. In this regard, defining a common framework to assess the performance of an autonomous controller under different conditions, while allowing inspecting the integration between P&S. This will rely not only in more robust controllers, but also on a better understanding of autonomy in robotics.

For assessing autonomous controllers, we propose a framework, called On-Ground Autonomy Test Environment (OGATE), to support testing and evaluation for robotics. OGATE is supported on a methodology and a set of general and application independent metrics to generate objective evaluations, and a software tool to enable automatic benchmarking processes. In this presentation we introduce the OGATE framework and we provide a summary of the findings of its application to two autonomous controllers based on different P&S paradigms. First, the Goal Oriented Autonomous Controller (GOAC) developed under a European Space Agency (ESA) contract. Second, the Model-Based Architecture (MOBAR) implemented by the Universidad de Alcalá. Both controllers have been evaluated for a rover exploration mission under different operative conditions to test on-board planning. The results demonstrate the effectivity of the OGATE framework, which enables the comparison of the controllers, allowing a better characterization of the P&S integration in robotics.