

Extending the autonomy envelope of space applications: a research path

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This talk focuses on the concept of autonomy and describes a research path followed over the years on the design and implementation of software architectures for controlling complex subsystems operating in space, for example an exploration rover. The leading thread of the talk is the presentation of innovative ideas to increase the level of autonomy for an intelligent controller. Starting from the description of a mixed-initiative system developed within the ESA Mars-Express mission in operation at ESA-ESOC since 2005, the talk moves on to presenting a new interpretation of the known Sense-Plan-Act (SPA) autonomous and deliberation paradigm and some correlated software architectures. SPA is one of the core ideas to realize autonomous systems, and AI Planning & Scheduling, as well as their integration, are among the basic technologies it is based upon. Then, an extended paradigm, named Discover-Plan-Act is described, where state-of-the-art AI planning systems are integrated with Reinforcement Learning (RL) algorithms guided by intrinsic motivations (curiosity, exploration, novelty, surprise). A discussion about the future work and the open research challenges closes the talk.