Artificial Intelligence Planning and Scheduling Aboard INPE's Satellites

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The experiments aboard the Brazilian scientific satellites are currently thought to execute in a repetitive way, collecting, storing and sending data in a cycle that does not suffer great alterations. This way of dealing with the experiments operation fits perfectly to long-term scientific observation. There are, however, short-duration scientific phenomena of which occurrence, although predictable, are randomic – an ionospheric disturbance, for example, can take place at any time and last from minutes to hours. To better analyze these phenomena it may be important to increase the acquisition rate and / or the precision of the data collected by an experiment. This increases the consumption of memory and power beyond the originally predicted.

Due to the short duration and the difficulty to specify exactly when a phenomenon of this kind will occur, it is not enough to leave the ground operations team in charge of the satellite reconfiguration. The necessary time for the phenomenon to be reported and for the ground team to create and send a new operation plan to the satellite is in general much longer than the duration of the phenomenon, and in this case the scientific opportunity to adequately analyze it will have been lost.

There is then the need for allowing the experiment, when detecting the occurrence of a short-duration phenomenon, to request from the onboard computer the temporary reallocation of resources to be able to carry out a more detailed analysis, affecting the least possible the operation of the other experiments and the satellite itself. As the number of states in which the several satellite subsystems and experiments is huge, it becomes difficult the use of classical programming techniques to handle it. In this context the Artificial Intelligence (AI) Planning and Scheduling techniques is presented as a potential solution to be explored.

RASSO, a Resources Allocation Service for Scientific Opportunities (Kucinskis & Ferreira, 2006), is being developed at INPE (the Brazilian National Institute for Space Research), and uses AI Planning and Scheduling to allow a scientific satellite to temporarily modify its current operation plan in order to better analyze short-duration phenomena.

This paper describes the RASSO architecture, some of its main characteristics – as the use of the same programming language to develop the planner and describe the satellite model –, and the safe and gradual approach foreseen to validate this technology in future INPE's satellites. We finish listing the few cases of planning aboard spacecrafts, the NASA's RAX (Bernard *et al*, 1999) and CASPER (Chien *et al*, 2005), and comparing some of its features with the ones present in RASSO.

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