The strategic importance of space systems is growing in Europe, for civil and defence applications, such as satellite communications, Earth observation, satellite navigation, etc. Recent examples have shown that on-orbit collisions brought on by space debris are actual threats. On one hand, some space debris are routinely tracked, making collisions predictable, but the increase in collision alerts affects the cost of space missions' management. On the other hand, most debris items are untracked because they are too small, making prediction impossible and impacts unavoidable. The way to reduce vulnerability is then to reduce the severity of collision and the probability of occurrence.

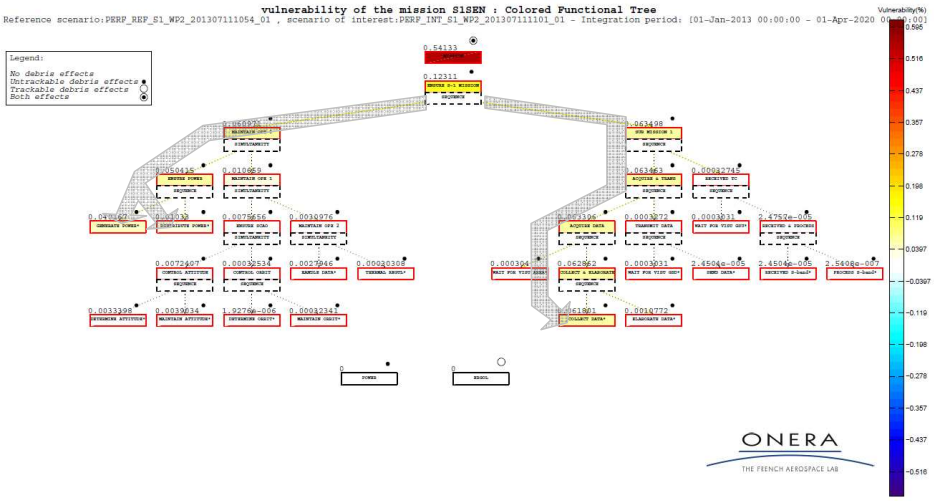
The P²-ROTECT project assesses the risks associated with space debris collisions and recommends possible solutions (better prediction, better protection or action on debris environment) to reduce vulnerability of future space missions with respect to on-orbit collisions. In order to make these recommendations, the project elaborated a vulnerability index and developed a tool SAVESPACE which quantifies the efficiency of solutions with respect to trackable and untrackable debris effects and which provides access to sensitive terms of collision probability or severity. Furthermore, trade-offs are made between efficiency and cost to propose new design options for future space infrastructures. In order to work with concrete examples depending on orbit types, three missions of interest for EU are analysed: Sentinel-1 in Low Earth Orbit, GALILEO constellation in Medium Earth Orbit and MTG, the weather observation constellation in Geostationary Orbit.

*Sentinel-1 is a radar imaging mission to be launched in 2014.*

*GALILEO – IOC with 18 satellites and FOC with 30 satellites.*

*Meteosat Third Generation First launch expected in 2018.*

The method developed during this project represents a breakthrough in the domain of vulnerability evaluation since it takes into account both types of debris and works at mission level in order to deal with component redundancies and possibly, system redundancies. Compared to classical methods, these method and tool avoid the overestimation of risks due to debris and allow trade-offs between solutions oriented towards avoidance of trackable debris and effect mitigation of untrackable ones.




*Vulnerability tree of the Sentinel-1 mission due to an event releasing a large number of debris (Period: 7.25 years).*