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Space systems — Avoiding collisions with orbiting objects

Systèmes spatiaux — Évitement des collisions avec les objets en orbite



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

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Introduction

This Technical Report describes the work flow for perceiving and avoiding collisions among orbiting objects, data requirements for these tasks, techniques that can be used to estimate the probability of collision and guidance for executing avoidance maneuvers.

The process begins with the best possible trajectory data, provided by satellite operators or sensor systems developed for this purpose. The orbits of satellites must be compared with each other to discern physically feasible approaches that could result in collisions. The trajectories so revealed must then be examined more closely to estimate the probability of collision. Should a collision be likely within the criteria established by each satellite operator, the spectrum of feasible maneuvers must be examined.

There are several different approaches to conjunction assessment. All have merits and deficiencies. Most focus on how closely satellites approach each other. This is often very uncertain since satellite orbits generally change more rapidly under the influence of non-conservative forces than observations of satellites in orbit can be acquired and employed to improve orbit estimates. Spacecraft operators require the fullness of orbit data in order to judge the credibility and quality of conjunction perception. This information includes the moment of time of the last elaboration of orbit (the epoch) and the standard time scale employed, state vector value or elements of orbit at this moment of time, the coordinate system description that presents the orbital data, the forces model description that was used for orbital plotting, and information about the estimation errors of the orbital parameters. Essential elements of information for this purpose are specified in ISO 26900.

There are also diverse approaches to estimating the probability that a close approach might really result in a collision. This is a statistical process very similar to weather forecasting. Meteorologists no longer make definitive predictions. They provide the probability of precipitation, not whether it will rain. All conjunction assessment approaches are in some way founded in probabilities. Probability of collision is also a highly desirable element of data. It must be accompanied by metadata that allows operators to interpret the information within their own operational procedures.

How near satellites might be to each other and the probability they might collide if they were that close are only two discriminants of potentially catastrophic events. Since the objective is that the satellite survives despite many potential close approaches, cumulative probability of survival is also important information. Responding precipitously to the close approach nearest at hand might only delay the demise of the satellite or even contribute to a subsequent more serious event. The evolution of orbits toward close approaches and the cumulative probability that a satellite might survive for a period of time are also important.

Finally, the state of each of the conjunction partners, their ability to maneuver or otherwise avoid contact, and the outcomes of past events that are similar guide courses of action.