**International Rendezvous System Interoperability Standards (IRSIS)**

<https://nasasitebuilder.nasawestprime.com/wp-content/uploads/sites/45/2019/09/rendezvous_baseline_final_3-2019.pdf>

There are 71 requirements for RDV system, as well as 12 requirements for its SECONDARY STATE DETERMINATION SYSTEM (SSDS)

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| **ID** | **Phase(s)** | **Actor(s)** | **Statement in IRSIS** | **Statement in FRETish** |
| RDV-001 |  |  | A synchronized, unified time information shall be maintained by all vehicles in the overall architecture, including visiting vehicles as well as the target vehicle |  |
| RDV-002 |  |  | Prior to the visiting vehicle’s AI maneuver, all visiting vehicle coast trajectories shall not intercept the AS for a minimum of 24 hours <TBC 3-5>. This ensures the target vehicle is safe from a visiting vehicle’s free-drift trajectory. |  |
| RDV-003 |  |  | The KOS shall only be entered via the approach corridor after authority to proceed (ATP) has been granted. |  |
| RDV-004 |  |  | The visiting vehicle shall be capable of execute abort commands issued automatically by its onboard systems, initiated by the onboard crew, or by external commands (from target vehicle crew or from ground controllers) that places the visiting vehicle on a 24-hour safe free drift trajectory |  |
| 005 - 008 |  |  |  |  |
| RDV-009 | Approach | visiting vehicle | When a visiting vehicle flies in automated mode, the visiting vehicle shall monitor the predefined “Automatic Abort Corridor” and perform an abort automatically if it senses a corridor violation. | In automated mode, if abs(aiming angle) >= 7.5°, the automatic abort command of the visiting vehicle shall be issued in [ T1, e.g. 0.1ms, yet to decide] |
| RDV-010 | The initial upper limit of the AAC shall be ±7.5° |
| RDV-011 | Approach | visiting vehicle (crew) | Any spacecraft crew (visiting vehicle or target vehicle), or ground operator shall monitor a predefined “Manual Abort Corridor”. | If abs(aiming angle) >=10°, the crew of the visiting vehicle shall issue abort command. |
| RDV-012 | Any spacecraft crew (visiting vehicle or target vehicle), or ground operator shall execute an abort command to the visiting vehicle if they observe a violation of the manual abort corridor. |
| RDV-013 | The initial size of the MAC shall be ±10° |
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| RDV-016 | Berthing Capture | Visiting vehicle | The net velocity of the visiting vehicle shall be less than 8 millimeters per second (mm/s), root sum squared (RSS) | In berthing mode, the visiting vehicle shall always satisfy velocity <= 8. |
| RDV-017 | Berthing Capture | Visiting vehicle | The net angular velocity shall be less than 0.04 degrees per second (deg/s) RSS <TBC 3-10> for the duration of the capture operation. | In capture mode, the visiting vehicle shall always satisfy angular\_velocity <= 0.04 |
| RDV-018 | Berthing Capture | Visiting vehicle | The visiting vehicle grapple fixture shall be 3.75 m or less from the visiting vehicle’s center of mass.  防止抓捕的时候不平衡 | In capture mode, the visiting vehicle’s grapple fixture shall always satisfy distance\_from\_visiting\_vehicle\_centerofmass <= 3.75 |
| RDV-019 | Berthing Capture | Visiting vehicle | The structural safety clearance shall be 1 meter <TBC 3-11> specific to the particular docking port. | The visiting vehicle shall always satisfy min(distance\_to\_dockingport) >= 1 |
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**Verifying safety of an autonomous spacecraft rendezvous mission**

Nicole Chan and Sayan Mitra

https://easychair.org/publications/paper/S2V

The rendezvous maneuver is divided into two-stages (three-modes including abort):

**Mode 1**: the chaser is attempting to rendezvous and its separation distance () from the target is in the range 100-1000m.

**Mode 2**: the chaser is attempting to rendezvous, and its separation distance is less than 100m.

**Passive (Passive Abort, Free drift)**: the chaser is no longer attempting to rendezvous and is not using its thrusters, regardless of its separation distance.

**Assumptions**:

1. We use the simplest case for relative motion in space, where the two spacecraft are restricted to the same orbital plane, resulting in two-dimensional, planar motion. Thus,
2. Target vehicle is in geostationary equatorial orbit (GEO), and the orbit is circular, so its angular velocity is constant: , where µ = 3.986 × 1014 m3/s2 and r = 42164 km.
3. Chaser (visiting vehicle) has a mass of mc = 500kg.

**Variables** :

Relative Position *x, y*

Relative Velocity *ẋ, ẏ*

Thrusts *Fx, Fy*

Global Timer *tmr*

**Constraints and safety requirements**

1. **Thrust constraints** During the rendezvous stages (Mode 1 and Mode 2), the thrusters cannot provide more than 10N of force in any single direction, therefore, we have the constraints: |Fx|, |Fy| ≤ 10.

FRETish: In mode 1 and mode 2, the thrusters shall always satisfy |Fx| ≤ 10 ∧ |Fy| ≤ 10

1. **LOS cone** **and proximity** During close-range rendezvous Mode 2, the chaser must remain within a line-of-sight (LOS) cone (see Figure 3), and its total velocity must remain under 5cm/s, so . The total velocity constraints cannot be exactly modeled using linear constraints, and a polytopic approximation over ẋ, ẏ is used. This is done in the same way as is approximated (see Figure 3).

FRETish: In mode 2, the visiting vehicle shall always satisfy 

1. **Separation** During the Passive mode, the chaser must avoid collision with the target, which is theoretically a point mass at the origin. Even in a theoretical model, a small ball or box should be used to bound this point to account for limitations in numerical precision. The target satellite’s dimensions may range from the order of 1m to 100m, so the size of this bounding box will vary depending on the situation. We use a box with a 0.1m circumradius.

FRETish: In passive mode, the visiting vehicle shall always satisfy distance ≥ 25