# 3.2 Proximity Operation Mission History

Rendezvous and proximity operations (RPO) missions have a long history in human spaceflight dating back to the first Gemini missions. It was not until the previous decade did interest arise in doing RPO missions with purely robotic applications. For the most part RPO missions have been solely under the purview of NASA and the military, only recently have private companies and universities made inroads in this area. Each mission has taken a different approach to RPO and has ranged from small CubeSats to massive multi-million dollar satellites. The successes and failures of these missions helped drive the constraints in the Rascal Mission.

Many of the RPO missions have been large million dollar satellites, out these missions three were selected for more analysis because these mission cover several different ways to approach RPO. The first spacecraft is the Demonstration for Autonomous Rendezvous Technology (DART) built by Orbital Sciences Corporation for NASA to develop and demonstrate autonomous navigation and rendezvous. It was to try to dock with an experimental communication satellite launched in 1999. The primary objectives of the mission were to navigate autonomously using GPS and rendezvous using the Advanced Video Guidance Sensor. Within a few hours of launch it was able to reach the target. It began to approach the target vehicle, but a malfunction occurred and caused a soft collision with the target vehicle leading NASA to end the mission. The total cost of the mission was $98 million. The next mission was Orbital Express, built by Boeing and Ball Aerospace and managed by Defense Advanced Research Projects Agency (DARPA) and Marshall Spaceflight Center. The Orbital Express mission was meant to show several servicing operations as well as rendezvous and proximity operations. It consisted of two spacecraft, one as the target and another to perform servicing operations on it. The primary spacecraft was able to refuel and replace the batteries of the target spacecraft. The final large spacecraft mission analyzed was the Micro-satellite Technology Experiment (MiTEx) mission. It consisted of three spacecraft working in geostationary orbit. One was an experimental satellite and the other two which served as inspection satellites. The inspection satellites, with mass of 225 kg each, were technology demonstration satellites capable of maneuvering in relation to other satellites and providing platforms to inspect other satellites without detection. The satellites demonstrated autonomous operations, maneuvering, and station-keeping capabilities. They were built by Lockheed Martin and Orbital Sciences and managed by DARPA. They were able to complete their mission with the experimental satellite, and then moved to inspect a failed missile detection satellite to find what went wrong. The total cost of the mission was $24.6 million.