Motivations

➢ Why tether-nets?
  ➢ reduced weight and volume
  ➢ compliance to pose, shape and state of the target
  ➢ can capture at a safe distance from spacecraft

➢ Reliability and safety of the process is critical as the same net can not be deployed more than once. Therefore, there is a critical need to identify systematic computational methods to control the net deployment in a manner that satisfies pertinent constraints under uncertainties.

State of the Art

➢ Interest in net-based systems to capture space debris is relatively recent

➢ Bombelli aimed at achieving a deployment that maximizes the volume of a 3D net, to ease the capture process [1].

➢ Effectiveness of deployment first analyzed by Chen and Yang [2] and Liu et al. [3]; sensitivity analyses were performed by Salvi [4], Botta et al. [6] and Shan et al. [5], in the absence of a tether linking the chaser and the net.

➢ Very little work into studying the effects of uncertainty attributed to imperfect state estimation of debris, spacecraft control, and launching of the net. Preliminary work done in [7].

Objectives

Computationally expensive simulation making the optimization process intractable:

➢ Machine Learning modelling of the net deployment

Net-design parameters directly influence net-launch-parameters for optimum deployment:

➢ Robust net design optimization (Monte Carlo sampling) with sensitivity analysis

High uncertainty in target state estimation, net-launch control, and chaser control:

➢ Launch control optimization by robust optimal planning

References

3. H. Lu, Qingbin Zhang, Leping Yang, and Yanwei Zhu, IAC, 2013
4. Samuele Salvi, Politecnico di Milano, 2014