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A method for sampling debris laser ranging data to generate range rates for orbit determination

The ILRS normal point generation method is an effective method for creating an averaged observation using binned full rate range residuals. For objects equipped with retro reflectors, the signal return is such that a normal point may be reliably generated. When laser ranging uncooperative objects (i.e. objects with no retro reflectors), often the signal return is less consistent and the orbit predictions less accurate. In this paper, the generation of smoothed range and range-rate points is presented for debris objects. Due to the rate of the observation collection, the shot-by-shot variability may be reduced by considering surrounding points and fitting. During this process an estimate for the range rate is also generated, improving the estimate of the orbit geometry. The Space Debris Tracking Station at Mount Stromlo, Australia is equipped with a CCD camera tracking system so that accurate angular data is collected with the laser ranging data. If the angular data is sampled using a similar method as the range observations, a state vector may be generated for each observation using the six-dimensional observations. This has important implications in reliable orbit determination from sparse tracking data. The benefits of the sampled observations and their rates is demonstrated for debris objects.