Gaussian processes (GPs) are non-parametric probabilistic regression models that are popular due to their flexibility, data efficiency, and well-calibrated uncertainty estimates. However, standard GP models assume homoskedastic Gaussian noise, while many real-world applications are subject to non-Gaussian corruptions. Variants of GPs that are more robust to alternative noise models have been proposed, and entail significant trade-offs between accuracy and robustness, and between computational requirements and theoretical guarantees. In this work, we propose and study a GP model that achieves robustness against sparse outliers by inferring data-point-specific noise levels with a sequential selection procedure maximizing the log marginal likelihood that we refer to as relevance pursuit. We show, surprisingly, that the model can be parameterized such that the associated log marginal likelihood is strongly concave in the data-point-specific noise variances, a property rarely found in either robust regression objectives or GP marginal likelihoods. This in turn implies the weak submodularity of the corresponding subset selection problem, and thereby proves approximation guarantees for the proposed algorithm. We compare the model's performance relative to other approaches on diverse regression and Bayesian optimization tasks, including the challenging but common setting of sparse corruptions of the labels within or close to the function range.

The amount of debris in orbit has increased significantly over the years. With the recent growth of interest in space exploration, conjunction assessment has become a central issue. One important metric to evaluate conjunction risk is the miss distance. However, this metric does not intrinsically take into account uncertainty distributions. Some work has been developed to consider the uncertainty associated with the position of the orbiting objects, in particular, to know if these uncertainty distributions overlap (e.g., ellipsoids when considering Gaussian distributions). With this work, we present fast solutions to not only check if the ellipsoids overlap but to compute the distance between them, which we call margin. We present two fast solution methods for two different paradigms: when the best-known data from both objects can be centralized (e.g., debris-satellite conjunctions) and when the most precise covariances cannot be shared (conjunctions of satellites owned by different operators). Our methods are both accurate and fast, being able to process 15,000 conjunctions per minute with the centralized solution and approximately 490 conjunctions per minute with the distributed solution