Identification of Asteroid Collisional Families and Orbital Groups through Computational Clustering Techniques

Yun, Annie

Asteroid collisional families and orbital groups are crucial towards tracing back the history of solar system collisions and in identifying unusual alignment factors, such as hypothetical outer planets or passing stars. The recent advent of Sky Digital Surveys creates an urgent need for techniques that allow for accurate and meaningful processing of huge quantities of data. Computational clustering techniques can allow for the agglomeration of data across physical and orbital properties and can operate beyond inconsistencies present in existing classification and categorization schemes. Thus this project puts forth potential collisional families and orbital groups that have not been previously fully identified. Dataset scaling was optimized through comparison between resulting clustering through Rand indices, allowing for meaningful weighting and separation of variables. Agglomerative hierarchical clustering techniques were modified and enhanced, resulting in dense and well-separated clusters as quantified by high silhouette coefficients. Comparison with clusters and families identified in literature allowed for verification of clustering techniques. Leveraging computational clustering techniques demonstrates plausible identification of collisional families and orbital groups with high cluster validity measures and scalability to the size of datasets being collection by sky digital surveys.

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