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PERFORMANCE ANALYSIS OF THE DEBRISAT DEBRIS CATEGORIZATION SYSTEM DATABASE ENGINE

Abstract

DebriSat is an ongoing hypervelocity impact test experiment that aims to update existing orbital debris breakup models by generating new breakup data based on modern satellite manufacturing processes and materials. The subject of the hypervelocity impact test was a representative model of modern LEO satellites. The experiment is now in the post-impact phase where debris fragments generated by the impact test are collected, characterized, and cataloged. Currently, the project has recorded over 120,000 fragments. Each fragment has around 30 raw characterization data fields such as mass, color, and shape, and up to 150 additional fields to store imagery data used to determine size and dimensions. Furthermore, each record contains additional metadata fields used to track debris fragments such as chamber location, version history, and verification status.

The task of managing DebriSat's large number of data and relational links posed a classic big data management challenge. In response, the Debris Categorization System (DCS) was designed and implemented. The DCS is a relational database-based solution that consists of a front-end web-based user interface and a robust back-end database engine. The DCS back-end is based on the MySQL database engine. For each debris fragment with imagery data, images are stored externally with paths to the data stored in the database. As the DCS continued to grow and expand to encompass new characterization techniques such as three-dimensional space carving, it became clear that the preferred method of storing imagery data was storage directly in the database engine. In this way, all characterization data can be packaged in a single location and queried directly. However, storing binary image data directly in a database engine induces performance losses depending on the query being executed.

Two of the foremost database engines are Oracle's MySQL and Microsoft's SQL Server (MSSQL). Together, these two database engines appear in a wide range of applications and support a majority of relational database systems. MySQL and MSSQL provide different levels of performance for different types of data and configurations. For example, MSSQL includes hybrid configurations such as FILESTREAM specifically designed for filesystem-based transactions. This paper presents a performance analysis of these two database engines implemented for use with the DebriSat DCS across multiple use cases and test scenarios. Ultimately, the goal of this paper is to provide useful data that can be used by other experiments with similar data management needs to choose the best database engine for their application.