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LEVERAGING WEB DATA AND GRAPH STRUCTURES TO SUPPORT RAPID SPACE OBJECT
IDENTIFICATION

Abstract

New innovative technologies and business models are continuing to reduce the cost of launch and manufacture of space infrastructure, paving the way for increased participation in the space industry by corporations, start-ups, academia and emerging space powers in developing countries. As earth-orbital environments become increasingly populated, Space Situational Awareness (SSA) and Space Traffic Management (STM) capabilities will be key to mitigating hazards associated with debris and collisions on orbit.

It is proposed that data relevant to both SSA and STM initiatives can be sourced from the World Wide Web (Web data), and that to this date Web data in their various formats and structures have been largely underutilised or simply overlooked as a useful dataset to support SSA problems. This work aims to curate a new data-set synthesised from publicly available Web data, including databases, catalogues, launch schedules, news media articles and documents relating to space operations. Data is obtained from internet sources using Information Extraction techniques (including Web-scraping and Natural Language Processing), then represented and stored in a graph database structure. Graph databases provide the best framework to represent and query complex and dynamic relationships in diverse datasets. Today they are widely implemented in commercial and business applications, and have had significant impact by diversifying the types of data captured and queried to generate new insight supporting decision making and strategy. For the same reasons, it is expected that graph databases will have a significant impact when applied to the domains of SSA and STM which currently rely primarily on observation data.

There are many challenges in identifying newly launched objects, especially for small satellite operators who may have limited access to physical observations shortly after launch. Small satellites often launch in clusters through rideshare opportunities, further complicating the task of correlating objects and their orbits during the critical stages of early operations. As an example application, this paper explores the benefits of graph database structures to associate data extracted from Web sources with observation data to support rapid identification of newly launched spacecraft. Curating a graph database which draws together the vast amounts of Web data related to SSA and STM, and makes this data accessible in a common format, is likely to benefit a broad range of activities related to safe and sustainable space operations.