

Assessing the Underworld Ontology for Integrated Inter-asset Management

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Assessing the Underworld (ATU) is the latest project in an interdisciplinary partnership, largely funded by EPSRC, embarking upon the ambitious vision to make street works more efficient and sustainable. ATU addresses key challenges, such as asset maintenance, repair and replacement planning, condition assessment of the buried pipes and cables, the influence on inter-related assets, the costs associated with economic and societal impact, as well as the deterioration of the buried utility infrastructure. One of the ATU work streams deals with developing a proof-of-concept decision support system (DSS) to exploit the data and knowledge garnered in the project to facilitate the assessment of the underground by different classes of users.

The ATU DSS will provide an interactive interface to support inter-asset management decisions by integrating and reasoning with diverse information sources about assets and their relationships. This is based on three main components:

- (1) A Knowledge Base which comprising of a suite of ontologies linked to real world datasets.
- (2) Deterioration models which are used to calculate the risk of an asset failure (e.g. pipe burst) and suggest the appropriate time to take actions.
- (3) Cost models which are used to compare the outcomes of different options for decision makers and suggest a cost efficient option.

At present, the ATU knowledge base includes two ontologies. The core ATU ontology defines the main concepts of buried assets (e.g. pipes), ground conditions (e.g. soil), land cover (e.g. roads), environment and human activities; and specifies relationships between assets (e.g. water pipe fault and road are related because the repair of a water pipe fault would require digging the nearby road). Using this ontology, the ATU DSS will aid holistic integrated inter-asset management by exploring the likely impact of human actions (e.g. digging a hole to repair a fault) on other assets and the environment. The second ATU ontology describes sensors and observations, linked to asset parameters and faults, as well as the work flow for sensing assets and underground environments. This ontology will augment the decision process by allowing the user to assess the likely benefits and limitations of using sensors for sustainable asset management.

The ATU ontologies are being developed by an interdisciplinary involving knowledge engineers, civil engineers and utility management experts. Sources of knowledge are derived from the literature, related ontologies (e.g. SWEET¹ or SSN²), existing guidelines (e.g. National Land Use Database, classification of soil BS EN ISO 14688), authoritative datasets (e.g. British Geological Survey, UK Water Industry Research, etc.), data collected by other ATU work streams, as well as domain experts from the ATU consortium.

¹ <https://sweet.jpl.nasa.gov/>

² <https://www.w3.org/2005/Incubator/ssn/ssnx/ssn>