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Framework for Novel Instance Generation from Exploration of Unknown Domains

Background

The vast amounts of data acquired by spacecraft instruments provide rich insights into observed planetary surfaces. However, the downlinking of data over a limited bandwidth between missions can transmit only a subset of the acquired observations. This subset selection does not leverage any automated intelligent decision-making strategy aimed at identifying the scientifically significant portions of data. This may result in the loss of valuable observations for subsequent expert analysis. Although there exist some autonomous decision-making modules that identify specific types of novelty, no multipurpose solution is currently available. Therefore, a generalized and adaptive solution may not only improve data processing efficiency for space missions, but also broaden applicability to other data-intensive domains including medical devices and autonomous vehicles.

Invention Description

Researchers at Arizona State University have developed an innovative framework able to identify novel data instances from observations of a previously unknown environment. A dynamic “interestingness” metric is defined in an application-specific manner and can be updated according to expert recommendations and scientific goals. A novel instance generation algorithm is proposed that takes sensor observations of the unknown environment, expert guidance in the form of association rules, and interestingness metric as input and outputs novel instances that are predicted to be most interesting for further analysis. This technique can be applied to generate unseen use cases for mission-critical automated control systems such as artificial human organs, autonomous vehicles, and satellite imaging.

Potential Applications

- Mission-critical control systems
- Planetary surface exploration
- Automated medical devices
- Autonomous vehicles

Benefits and Advantages

- Intelligent – Able to identify and prioritize high-value datasets for efficient gathering and distribution
- Versatile – Generalized decision-making framework extends capabilities across a range of applications
- Practical – Incorporates expert knowledge and domain-specific rules to increase consistency of results with real-world decisions on data relevance

[Laboratory Homepage of Professor Sandeep Gupta](#)