R&D 100 WINNER

GENIE: Evolving Feature-Extraction Algorithms for Image Analysis

Features

GENIE (GENetic Imagery Exploitation) mimics evolution in order to create more-effective algorithms for detecting features in digital images produced by a variety of remote-sensing techniques. GENIE assembles an initial set of low-level image-processing algorithms (e.g., edge detectors, texture measures, and spectral operators) and then tests each algorithm's ability to find the feature of interest. The "less fit" algorithms are discarded; the "more fit" ones are combined to produce superior ones. After several generations of survival of the fittest, the resulting algorithm is highly optimized. Although features and imagery constantly change, GENIE's ability to evolve superior algorithms allows it to find the features of interest in nearly any set of images.

Applications

GENIE can be used to
- map damage caused by wildfires, snowstorms, tornados, hurricanes, floods, tsunamis, earthquakes, volcanoes, or terrorist attacks,
- monitor environmental changes or crop health,
- track population growth,
- detect signs of disease in medical images,
- detect defects in products made in assembly lines,
- detect weapons and explosives at airport security checkpoints,
- detect suspect vehicles in traffic, and
- create maps of craters, canyons, and plateaus on other planets to assist in choosing landing sites.

Benefits

Analysts with no programming experience can quickly learn how to use GENIE to evolve algorithms that extract specific features from digital images.

GENIE's results can be reused to help GENIE build up its "understanding" of complex tasks. (For example, after GENIE learns to find water, it then can easily learn to find beaches.)

GENIE learns to ignore unimportant image-to-image variations such as atmospheric haze or variations in overall illumination.