



University of Central Florida

Technology Available for Licensing

tt.research.ucf.edu

High-Accuracy Structural Health Monitoring Method Detects Small Pattern Changes with Fewer Sensors

Introduction

UCF researchers have developed a way to detect small pattern changes in sensed data, particularly in field monitoring applications, using auto-modulating pattern (AMP) detection. Small pattern changes are difficult to identify in the presence of substantial environmental effects that act as noise and conceal them. In some situations, such as monitoring the tilt of a retaining wall over time or monitoring ice formation on a road, the data that's needed to draw a conclusion from the sensor's analysis is obscured by larger environmental effects. When detecting ice on a road, the effects of ambient temperature are much greater than the effects of precipitation. In the case of the retaining wall, the higher-magnitude effects of temperature expansion and water content in the soil and porous concrete make it difficult to identify smaller movements with bigger potential consequences.

The new method makes accurate and reliable condition assessments possible with fewer sensors. The non-parametric AMP method works independently of physical assumptions or simplifications that can limit conventional methods and can be used for structural health monitoring of a variety of structures including buildings, bridges, tunnels, dams, etc. The method can be implemented using a device that incorporates a sensor integrated with an embedded computer to transfer already-processed data, in addition to raw data, to trigger alerts if a structure is at risk of failure.

Technical Details

Various types of sensors can be used for AMP detection including: displacement, velocity, acceleration, strain, slope, temperature and the like. To detect small pattern changes with AMP, a raw signal is collected by a sensor over time and used in conjunction with a reference signal created using a mathematical function with known amplitudes and frequencies. The reference signal is added to the raw signal to form a modulated signal, which is then decomposed. Time-frequency analysis conducted on the decomposed signal exposes abnormal patterns, and the occurrence of small pattern changes can be interpreted from the results.

AMP improves the detectability of anomalous event occurrence by amplifying small effects, masked by dominant forces, in two ways: signal-to-noise ratio and temporal resolution of detection. AMP improves the signal-to-noise ratio by increasing the peak magnitude of the event and/or reducing the fluctuation of the baseline frequency. Temporal resolution is improved using a higher frequency of the user-defined modulating sinusoidal signal than the frequency of the dominant effect, reducing peak width.

UCF Inventor

Hae-Bum Yun, Ph.D.



Benefits

- Detects small patterns through environmental noise
- Improves detectability of anomalous events
- Can be incorporated in a detection unit or used as an independent analysis method

Applications

- Structural health monitoring
- Surface condition monitoring

Tech Fields

Sensors,
Signal Processing

Keywords

structural health monitoring,
small pattern changes,
construction, infrastructure, civil
engineering

Patent Application Pub. No

US 2012/0303312 A1

If you or your company are interested in this opportunity, Contact:

Raju Nagaiah | 407.882.0593 | Raju@ucf.edu | Tech ID# 32433

UCF Office of Technology Transfer | 12201 Research Parkway, Suite 501, Orlando, FL 32826