Geophysical Research Abstracts
Vol. 20, EGU2018-18815, 2018
EGU General Assembly 2018

Identification of geologic or structural hazard signals using high-precision GPS/GNSS

Don Kim (1)

(1) Korea Research Institute of Ships & Ocean Engineering, Daejeon, Korea (donkim@kriso.re.kr), (2) University of New Brunswick, Geodesy and Geomatics Engineering, Canada (kim@unb.ca)

GPS/GNSS-based infrastructure health monitoring is an advanced geodetic application originated from high-precision GPS/GNSS that improves the safety and maintainability of critical civil structures and natural features. Unlike geotechnical or structural health monitoring instrumentation, a GPS/GNSS sensor can be easily installed on a structure already in operation and complements conventional sensors by providing redundant health status information. It has been designed for monitoring "semi-static" civil or earthen structures that are considered to be stable. Due to physical occurrences, however, these structures normally illustrate small movements. By continuously monitoring the state of the structure, an awareness of abnormal conditions can be obtained. Failure of a civil infrastructure can cause much destruction to life and property.

In civil structure monitoring, our primary interest is to identify geologic or structural hazard signals such as the seasonal cycle of thermal expansion and contraction of the structure. As geophysical signals are typically modulated in GPS/GNSS positioning time series, therefore, it is important to isolate such signals by geodetic analysis. It is well known that the residuals or unmodelled components of the solid Earth tide or any periodic geophysical signal such as ocean (and atmosphere) tide loading propagate into GPS/GNSS positioning time series at predominantly semi-diurnal and diurnal frequencies. Such aliasing propagates sub-daily errors in modelling of periodic signals into erroneous effects at frequencies of geophysical interest, in particular, annual and semi-annual signals. These spurious low frequency signals in geodetic time series have the potential to mask geophysical signals of interest including the seasonal signals associated with the hydrological cycle, atmospheric loading and non-tidal ocean mass loading.

To isolate geophysical signals modulated in GPS/GNSS positioning time series, we use a relative positioning approach which is typical in a civil structure monitoring application. In this case, it is safe to ignore the impact of any periodic geophysical signal to ‘relatively-determined’ GPS/GNSS positioning time series. However, we will present two critical cases demonstrating that semi-diurnal and diurnal frequencies are still modulated in the relative GPS/GNSS positioning time series – dam and building deformation monitoring. These eventually can mask geologic or structural hazard signals of interest in civil structure monitoring.