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A database system for archiving and dissemination of structural monitoring data

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Rapid developments in sensor and communication technologies in recent years, and the continuous decrease in the price of related equipment, have led to a sharp increase in the number of civil engineering structures that are installed with real-time monitoring systems. Such applications are commonly known as Structural Health Monitoring, SHM. A wide range of sensors are used for SHM, including acceleration and velocity sensors, tilt-meters, strain gauges, temperature sensors, and GPS sensors. Due to the fact that these sensors can all have different specifications and data characteristics (e.g., installation requirements, sampling rates, data processing and analysis procedures), the data from each sensor group should be handled separately. Also, the identification of some of the dynamic properties of the structure (e.g., torsional and rocking components of its vibrations) requires that the location of each sensor be specified at a minimum with a centimeter precision. This cannot be accomplished by using geographic coordinates. Typically, a user of SHM data would ask for the entire data from all the sensors in the structure, rather than the data from one individual sensor. Because of all these, the database systems that are used by seismologists for earthquake data are not very practical to archive and disseminate SHM data.

Realizing that, we at the Kandilli Observatory and Earthquake Research Institute (KOERI) of Bogazici University in Istanbul are developing a database system specifically for archiving and disseminating SHM data. The database will allow a user to select and download the data based on a wide range of selection criteria, such as the geographic region, structural type, foundation system, soil type, construction date, sensor type, magnitude range, epicenteral distance (for earthquakes), etc. The system is similar and improved version of the COSMOS Database system used by the California Department of Conservation in the US. The data are downloaded in the form of two files for each sensor type. The first file is a matrix, where columns of the matrix corresponding to the channels of that sensor type. The second file is a text file (e.g., a PDF file) presenting the locations and orientations of the sensors, sampling rates, sketches, pictures, and other relevant information for that sensor group. The location of the structure is defined in terms of the geographic coordinates of a reference point within the structure, whereas the location of sensors are defined in terms of the x,y,z coordinates in centimeters with respect to a Cartesian coordinate system centered at the reference point.

Examples for the use of the database are presented.