cyberBridge PROJECT OVERVIEW

Objectives

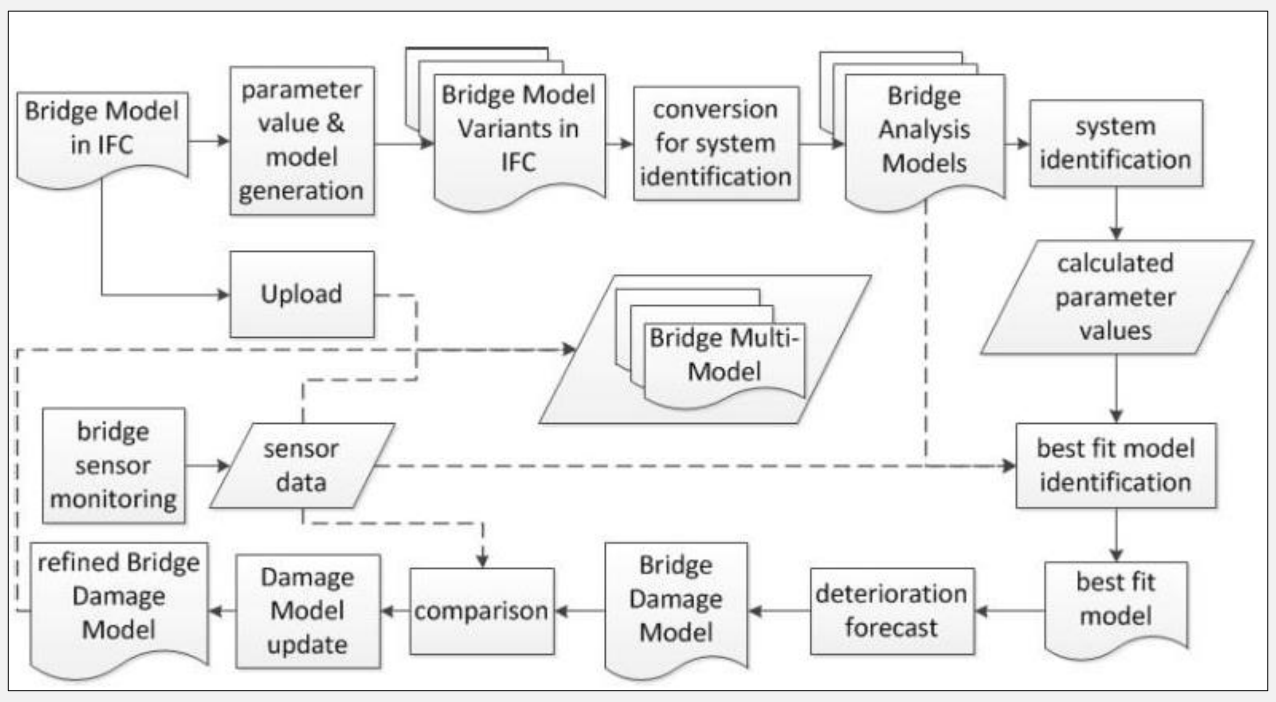
The goal of cyberBridge is to radically improve bridge monitoring and forecasting. The main result will be an innovative BIM based cyber-physical system for bridge assessment comprising continuous bridge and load monitoring, continuous vehicle load and bridge system identification for global and local crack propagation deterioration, and forecasting using mass simulation and probabilistic methods. It will be provided as a continuous monitoring platform with online evaluation. The automated use of HPC (Cloud/Grid) power will allow deep system identification at any time providing for much better understanding of the deterioration process and the impact of each deterioration event on the reliability of the bridge.

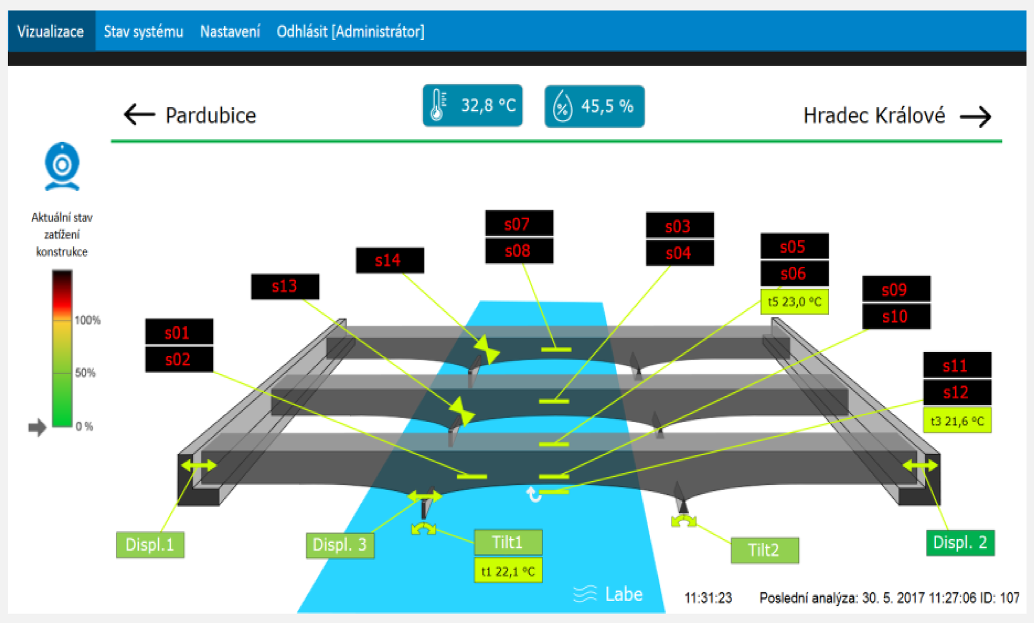
The system will be capable of continuously detecting micro cracks and the deterioration state as well as its changes on a much more precise level and a higher confidence than today's monitoring systems and keeps monitoring costs at about the same level. This is based on several new methods:

1. A new continuous simulation-based system identification method for global and local behaviour identification using massive Grid/Cloud simulation
2. Load monitoring systems for identification of individual vehicles and their synchronisation with monitored values
3. Reliable, accurate prediction of the remaining lifespan and retrofit measures on the basis of the identified system
4. BIM, Multimodel and ontology-centred flexible and efficient mass information management and visualization of the results via a 3D bridge navigator
5. Improved sensor system layout, modification and tuning process for global and local bridge system identification
6. Improved sensor network with max 1ms delay.

Approach

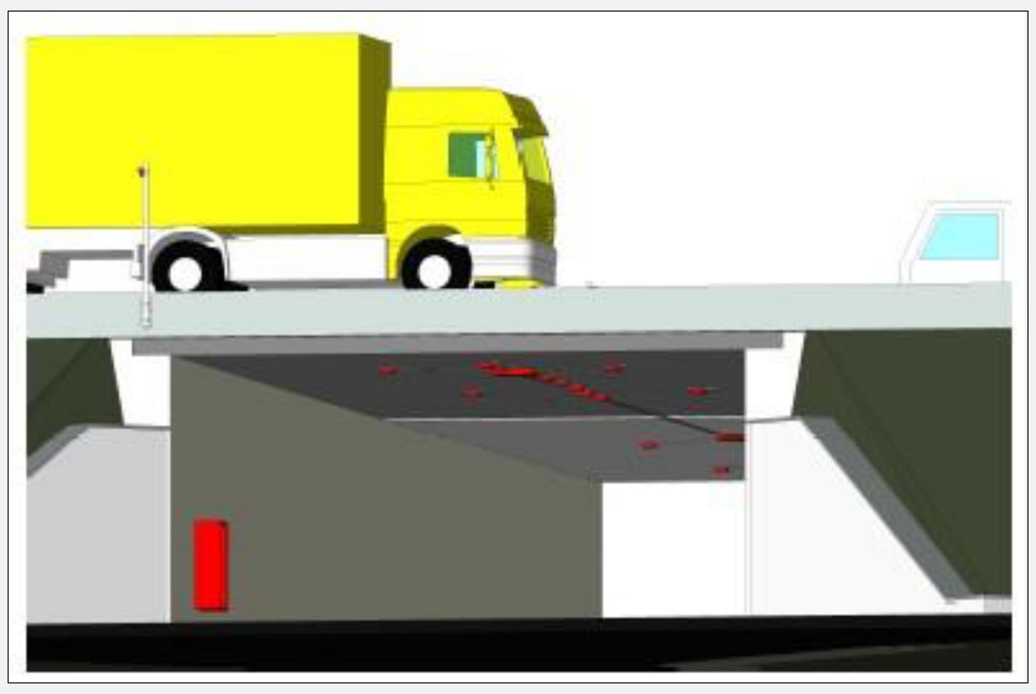
cyberBridge focuses on new ICT technologies in 3 main areas:
1. Multimodel and BIM information management and display
2. simulation-based system identification
3. online assessment enabled by continuous numerical analysis of the monitored data in a Cloud/Grid environment and on advanced developments in vehicle identification, nonlinear structural and probabilistic analysis.

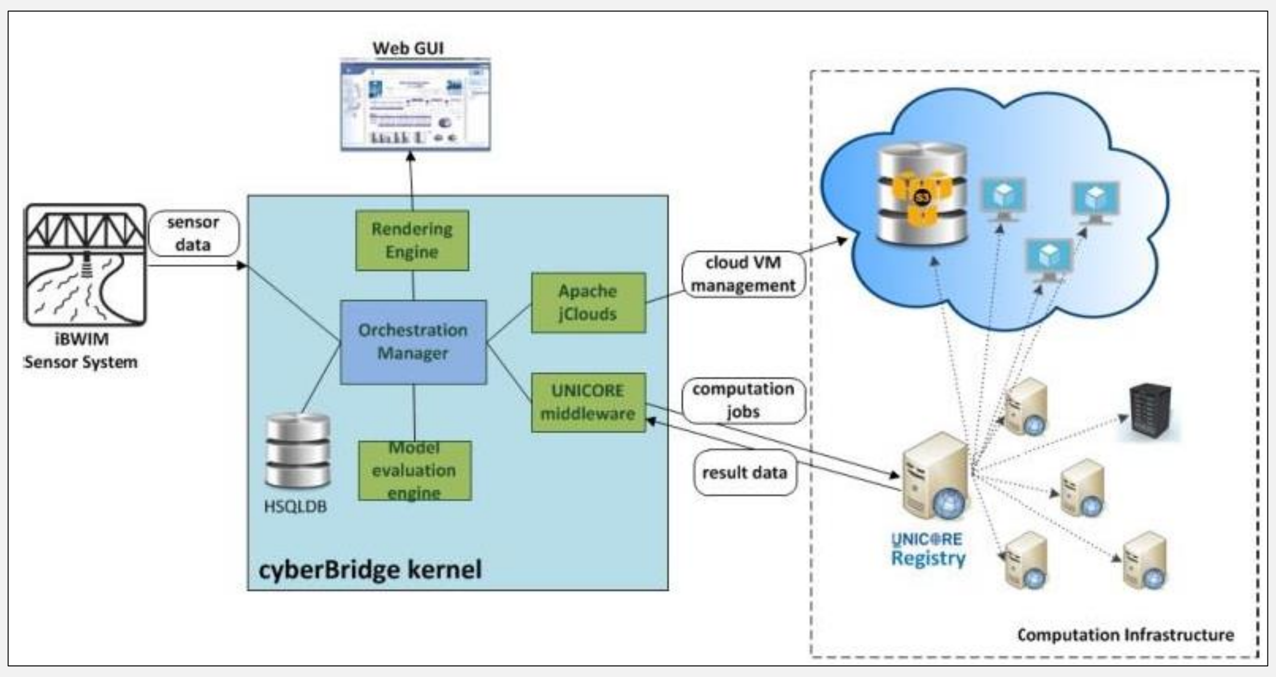




Advanced BIM technology and the new Multimodel method are utilized to create a semantic 3D model of the bridge, explicitly interlinked with mass stored monitoring information, deterioration data, sensor data and probabilistic models. Combined with enhanced monitoring technology, this will improve the bridge assessment to the level of a cyber-physical system and hence move bridge monitoring to a continuous ICT driven monitoring process.

Reactions can be measured at predefined locations equipped with sensors, whereby the related load values are typically not directly measurable but can be derived on the necessary quality on vehicle basis using the iBWIM method of PSP. If the sensor locations are significant for the system behaviour, precise system identification can be carried out to conclude on deterioration i.e. developing cracks. An analytical approach is thereby unrewarding and very time consuming due to the high number of unknown parameters. Therefore, an automated numerical simulation approach for the solution of the system identification problem is suggested which will enable fast generation of meaningful structural model variations on the basis of the continuously updated BIM model by the identified actual deterioration state. These generated models will be analysed simultaneously on the Cloud/Grid environment and the set of models best fitting to the measured values will be automatically identified. The necessary analysis time will be reduced to hours instead of the weeks needed for classical structural analysis. This method enables also the evaluation of system changing in time i.e. the evaluation of trends.





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