Structural health monitoring system for bridges based on skin-like sensor

Konstantinos Loupos[1], Yannis Damigos[1], Angelos Amditis[1], Reimund Gerhard[2], Dmitry Rychkov[2], Werner Wirges[2], Manuel Schulze[2], Sotiris-Angelos Lenas[3], Christos Chatziandreoglou[3], Christina M. Malliou[3], Vassilis Tsaoussidis[3], Ken Brady[4] and Bernd Frankenstein[5]

[1] Institute of Communication and Computer Systems, 9 Iroon Polytechneiou Street, Athens, 15773, Greece
[2] University of Potsdam, Institute of Physics and Astronomy, Karl-Liebknecht-Strasse 24-25, 14476 Potsdam, Germany
[3] Democritus University of Thrace, Department of Electrical and Computer Engineering, Kimmeria Campus Xanthi, 671 00, Greece
[4] TRL limited, Crowthorne House, Nine Mile Ride, Wokingham, RG40 3GA, UK
[5] Teletronic Rossendorf GmbH, Bautzner Landstraße 45, Radeberg, 01454, Germany

E-mail: kloupos@iccs.gr

Abstract. Structural health monitoring activities are of primal importance for managing transport infrastructure, however most SHM methodologies are based on point-based sensors that have limitations in terms of their spatial positioning requirements, cost of development and measurement range. This paper describes the progress on the SENSKIN EC project whose objective is to develop a dielectric-elastomer and micro-electronics-based sensor, formed from a large highly extensible capacitance sensing membrane supported by advanced micro-electronic circuitry, for monitoring transport infrastructure bridges. Such a sensor could provide spatial measurements of strain in excess of 10%. The actual sensor along with the data acquisition module, the communication module and power electronics are all integrated into a compact unit, the SENSKIN device, which is energy-efficient, requires simple signal processing and it is easy to install over various surface types. In terms of communication, SENSKIN devices interact with each other to form the SENSKIN system; a fully distributed and autonomous wireless sensor network that is able to self-monitor. SENSKIN system utilizes Delay-/Disruption-Tolerant Networking technologies to ensure that the strain measurements will be received by the base station even under extreme conditions where normal communications are disrupted. This paper describes the architecture of the SENSKIN system and the development and testing of the first SENSKIN prototype sensor, the data acquisition system, and the communication system.