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Integrating in situ and remote technologies for long term SHM of transport infrastructures

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Considering the relevant number of aging existing structures and infrastructures it is necessary to setup protocols able to support decision related to retrofit programs and to plan/upgrade emergency plan in case of disaster. In this way, the development of monitoring systems for critical structures and transport infrastructures is gaining an increasing interest around the world, as demonstrated by the technical and scientific literature and from the significant number of funded recent research projects in this topic. Critical transport infrastructures have experienced (especially the bridges) significant safety criticalities, which in few cases led to collapse with significant social and economic impacts. Criticalities are due to different causes, such as: ageing; low quality and misconceptions of the design; not proper use of the technologies in the construction; low quality of the materials; lacking of insufficiency of a reliable maintenance planning; not reliable awareness of the hazards; increased loads respect to design data; underestimation of the performances of the structure due to a non updated knowledge of the healthiness status, collocation in unsuitable sites. In many cases, these causes operate in synergy to each other. In this frame, the paper discusses about the necessity of holistic approaches/visions based not only on the integration of different sensing technologies, but more important on a multidisciplinary approach encompassing disciplines related to the sensing, ICT, positioning technologies and civil engineering. In this general frame, attention is also focused on the embedded miniaturized sensors, which have the main advantage to ensure an always updated long term monitoring and provide a early-warning. In addition, the possibility to embed the sensors directly in the structure during its construction allows to have a clear vision of the structure at the “time zero” of its lifecycle, thus taking into account the entire life cycle of the structure (including its response to extreme events and the actual traffic load). Therefore, the paper will deal with the embedded sensors of specific interest for the civil engineering, but in the more general frame above sketched for. Finally, it is evident how that also if in the paper we will consider specifically the transport infrastructure, the same concepts can be applies for monitoring other kinds of critical infrastructures, urban areas (built environment) and cultural heritage.