

Assessment of Vibrations in Museum's Environment

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Abstract: This paper deals with measurement of mechanical vibrations and accelerations threatening objects in museum collections. Two case studies are presented. The first case analyses situation in museum exhibitions strongly influenced by street traffic in its close proximity. It compares results obtained by sensitive professional measurement system to the custom-built user device for acceleration recording. The second case analyzes object's accelerations during transport based on measurement by the custom-built device.

Introduction

The project “Unified modular system of remote on-line monitoring of environmental parameters of depositories and expositions” deals mainly with monitoring of parameters of internal environment in museums [1]. Among parameters like temperature, humidity and light intensity, also mechanical vibrations play important role in protection of collections objects. In order to protect the irreplaceable historical objects, sources of vibrations in museum have to be studied and if exceed safe level, also eliminated. As there is still an incomplete knowledge relating scale of mechanical load due to vibrations and their damaging effects on various object types, it is interesting experimental task to measure the true extent of vibrations and accelerations found in the museum environment [2]. Secondly, collections are shipped to different locations and the transport represents substantial impact on object's life. To properly assess the extent of loads during transport, mobile monitoring device accompanies it and records the events occurring during transport.

Case one - vibrations in museum

The Czech Museum of Music is situated in 19th century building located on street with a heavy traffic including trams. Each vehicle passing the building induces vibrations into the exposition, especially those due to trams are severe. The measurement performed in the museum had two major goals: quantify influence of traffic on vibrations of displayed objects and use the simultaneous measurement of the vibrations for comparison and “calibration” of custom made acceleration recording device. Satisfactory agreement between the two measurements was obtained, therefore the custom-built device was used with reasonable degree of confidence also in another experiments.

The measurement yielded the following findings: Comparing dynamical response to loads caused by street traffic between the two adjacent exhibition rooms suggests that the floor that shakes more is more compliant. Second finding confirms observations known from literature: humans are very sensitive detectors of vibrations, they get alarmed on levels of load that are two orders of magnitude lower prior any damage to objects can happen [2]. But the most important result is a proof that vibrations due to traffic are much smaller than those produced by visitors walking in the room.

Case two – dynamical loading during transport

The custom built device was used to analyze accelerations to which the transported object is subjected to. Dummy object playing role of a “precious artefact” was placed into padded suitcase typically used as transport box. Then the box was sent from Prague to Vienna and back with other true objects in exhibition exchange. Upon its arrival, the custom built device was retrieved and recorded data were downloaded into computer and processed. It was observed that the most severe forces arise from handling operation, when the box is handled – Fig. 1.

The innovative part of the device is its capacity to record simultaneously accelerations of the transport box and object using detachable sensor. This way quality of object’s protection from external forces can be assessed. The device can be therefore also used to optimize transport boxes and improve their protection properties. The true dynamic analysis of box-object interaction can reveal the necessity to relate compliance of interior padding to inertia of the protected object itself.

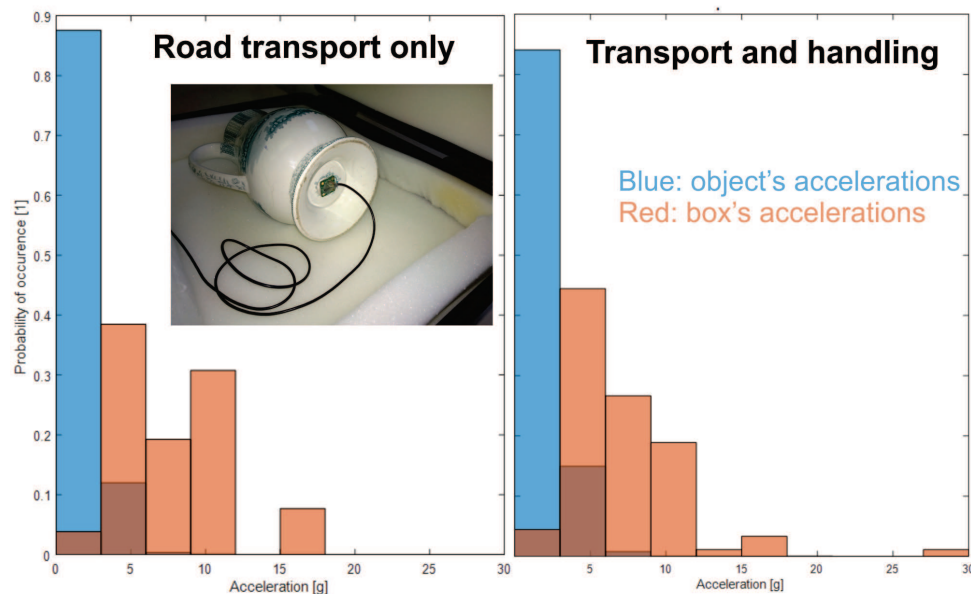


Fig. 1: Histograms representing distribution of accelerations measured on the transport box and on the object during transport only and also including handling. Significantly reduced portion of high acceleration events for object in comparison to transport box indicates that the object was properly protected.

Summary

Presented results cast interesting light on possibilities of experimental measurement of dynamical variables in environment distant from typical engineering practice.

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