DEVELOPMENT OF A DIAGNOSTIC TOOL BASED ON ACOUSTIC EMISSION TECHNIQUES FOR HISTORICAL VEHICLES' ENGINES

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INTRODUCTION

Historical vehicles have, besides their cultural values, the significance of their primary function as means of transport. Without this capability the object loses part of its cultural value. Vehicle engines, among the technical and industrial heritage objects with mechanisms, are particularly complex due to the large number of mechanisms involved in their operation.

The reactivation of these mechanisms is often a challenge for the conservators, in particular if the engine was stopped for a long period. In fact, the presence of corrosion products, the scaling of lubricants, surface scratches or gaps in contact pairs, can induce engine malfunction or even lead to its breakdown in case of reactivation.

The HE-Arc conservation-restoration of Neuchâtel and the Musée national de l'automobile in Mulhouse collaborate in the Acoustic Emission Monitoring of Historical Vehicles project (ACUME HV), which aims at developing acoustic emission methods as non-invasive tool for the diagnostic of historical vehicles' conditions. Acoustic Emission (AE) is a powerful tool already used in industry and some fields of cultural heritage and will be applied here for the first time to historical technical/industrial artefacts.

The development of diagnostic tools for the detection of malfunctions at the very early stages during reactivation will help the conservators to reactivate the mechanisms without damages while preserving the cultural values and the materials originality of the objects. In that sense, the use of non-invasive techniques, like AE, for the evaluation of the mechanisms condition will allow to restart the engines safely.

The first stage in developing the diagnostic tool consists of performing cold tests of a historical engine in order to extract the mechanical signature for different cold-operating conditions, such as normal conditions, air leakage, pin looseness or missing piston rings. In cold tests, the engine is disassembled from the vehicle and fluids from cooling and lubrication systems are removed. The motion is introduced moving by hand the engine's mechanisms thanks to a handle attached to the crank. Four AE sensors placed in selected positions of the engine recorded AE signals for different cold-operating conditions. These signals were treated using statistical analysis techniques and compared in order to point out the presence of malfunction features in the AE signatures.