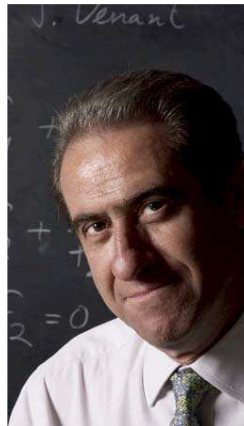


## Dynamical Tests and Analysis for the Assessment of Structural Conditions of Bridges

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### Summary

The assessment of the structural conditions of bridges managed by Local Public Territorial Authorities is analyzed in this work. The results of a campaign of repeated modal tests and a parallel program of visual inspections on a class of 100 bridges are reported. The tests and the analysis is used to rate the structural integrity of different classes of the analyzed bridges and to accordingly propose a maintenance program. Relevant case studies are reported to enlighten and discuss particular observed dynamic phenomena in arch bridges.

**Keywords:** Bridges, Dynamical tests, Monitoring systems, Structural health monitoring.

### 1. Introduction

The assessment of the structural conditions of bridges is a relevant task mainly concerning the optimal allocation of public money always lower than what is needed for an effective maintenance program. In most cases the bridges are monitored through visual inspections without performing any *in operational conditions* test [1]. Modal testing and damage identification are performed only in special cases when the relevance of the structure is high or the damage conditions are critical [2]. In fact, the structures, even interested by deterioration, are not subjected to extensive tests able to describe the evolution of the structural conditions, mainly for economic reasons. The extension of *in operational conditions* analyses to a large number of bridges is directly related to a simplification of *in situ* surveys and of testing procedures.

Structural health monitoring programs of bridges, based on ambient vibrations, is the objective of research programs conducted by the Universities of L'Aquila and Rome in cooperation with Local Public Territorial Authorities [2]. The use of dynamical tests results is twofold: *i*) to constitute the reference basis of the modal properties for the evaluation of their modifications due to damage, *ii*) to validate and update the bridges FE models to be used in the assessment stage [3].

In the present paper, the results of an extensive campaign of bridges modal testing, developed in a cooperation program between the Structural Department at University of L'Aquila and the Local Territorial Authority of the county of Teramo, are presented. Among one-hundred of bridges under analysis, fifty of them were dynamically tested up to three times. The testing and identification procedure has been applied to different bridge typologies, r.c. bridges (pre-stressed or not), masonry bridges, r.c. arch bridges. Because of the relatively large number of structures under analysis, an optimized test and identification procedures have been followed. The ambient excitation guarantees the low cost of the testing procedure conducted without closing the bridges [4-6]. Two different techniques have been used to identify the modal properties; both of them are based on output-only measures, the first method in the frequency-domain, the second method in time-domain. The results obtained were compared to the results furnished by the commercial software ARTeMIS [7].