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SCALING AND SIMILITUDES FOR VIBROACOUSTIC APPLICATIONS

Sergio De Rosa and Francesco Franco

pasta-Lab, Dept. of Industrial Engr., Aerospace Section, University of Naples "Federico II",
Via Claudio 21, Napoli, Italy - sergio.derosa@unina.it, francesco.franco@unina.it,
www.pastalab.unina.it

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In the engineering research and development activities, it would be highly desired to have scaled or similitude models for trading off purposes or simply to get more amenable working sizes. In fact, the possibility to transport the same engineering problem on different scales can provide several advantages. Thinking only to the geometry, a very small object could be investigated on a scale larger than the original one, so making easy for example the location of a given set of sensors/actuators; furthermore, very large components can be analysed in a standard laboratory with smaller surfaces to be controlled. This is particularly important for the vibroacoustic field, too, where the focus is related often to passengers volumes which are (i) enclosed by elastic surfaces and (ii) excited by external sound fields due to a fluid flow and/or mechanical sources. Fuselage, train and car cabins are classical examples of this category of problems. The *corpus* formed by [1], [2] and [3] represents a formidable ensemble to face with these problems, that is the possibility to define models or prototypes which are able to provide exact or controlled approximations of given items. Inside this general framework, the modal approaches still can be considered among the best tools since they are able to provide the output response of a linear system at a given point and at a given time (frequency). Thus, by combining the frameworks and the developments specifically presented in [4] and [5], it was possible to define a procedure which allows defining both scaled and similitude models. The proposed approach would formally invoke the process of full dimensional analysis, but it was preferred to work directly with the energy distribution approach (EDA) for investigating a dynamic system via the modes and natural frequencies in order (i) to have an *avatar* to be used to get specific information and (ii) to determine the power inputs and the energy exchanges associated to each subsystem. The definition of complete and distorted (incomplete) similitudes will be also pointed out. The results obtained during the last years, [6 7], will be here summarised and they will include some recent findings about the stiffened and unstiffened cylinders. Despite the simplicity of the proposed models, the results can be considered as really promising.

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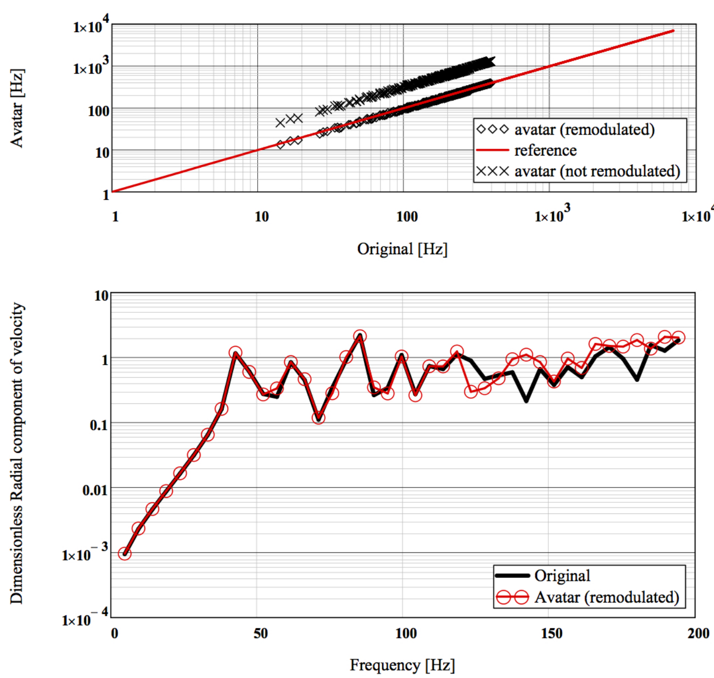

Figure 1: Analytical Responses for a Stiffened Cylinder: $L = 10\ m.$, $R = 1\ m.$, $h = 1\ mm.$