Guiding Noise and Vibration Design along General TRIZ Process by Misunderstanding Case List

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Abstract

To improve noise and vibration (NVH) performance is important in such products as motor vehicles and home electrical appliances. To improve NVH and other performances simultaneously requires inventive design solutions. The author presented his study on the effective application method of TRIZ on NVH design at the 4th Japan TRIZ Symposium. The method has two new and major tools. One of them enables the user classify particular problems into seven standard NVH problems and the other provides more than 40 standard NVH solutions. This paper discloses the results of study for improving this method further. The new feature is to place three kinds of knowledge bases (KB) in standard TRIZ process. The KBs prevent designers from side-tracking by showing negative examples. This method plays as a complement of normal TRIZ tools that attract people toward ideal directions.

Extended Abstract

To improve noise and vibration (NVH) performance is important in developing complex system products to be sold general customers as motor vehicles. In most cases, improving NVH performance and other performances are in trade-off relationships. For instance, if we increase stiffness of a car body, it tends to invite unnecessary weight increase and poor acceleration and fuel economy. Therefore, inventive design is required in this NVH engineering field.

The author has been trying to apply standard TRIZ process to NVH design. However, the author felt that to induce concrete design solutions in NVH field from the standard TRIZ solutions requests much experiences or strong insights that average engineers cannot have. Based on this observation, development of inventive NVH design process has been tried evolving from standard TRIZ process but maintaining its sprit. The developed process was partly reported in the 4th Japan TRIZ Symposium. In this process, seven categories are listed as the standard NVH problems, and more than 40 standard NVH solutions are prepared corresponding to them.

However, the author encountered some difficulties in applying the developed process in real NVH problem solving. Firstly, particular problems at hand were usually vaguely defined. To define particular problems clearly, experimental analysis must be properly conducted, and the exact phenomenon must be understood. However, wrong definitions of particular problems were frequently made by misunderstanding the principles of experimental analyses or the experiment result evaluations.

In the process of choosing standard solutions, misunderstandings of NVH design principles tended to lead to unrealizable solution selection. Further, in the process or finding a particular solution, the NVH performances of the solution must be predicted. If the designer misunderstands the principle of the CAE simulation, then miserable results would be obtained destroying all the precious TRIZ process.

To ease these difficulties, the author organized 70 cases of misunderstandings in three action phase, namely experimental analysis, design principle selection and performance prediction. These case descriptions are expected to guide designers along proper TRIZ track.

As shown in the figure 1, designers who improve NVH performances drastically can proceed to well defined particular problem using experimental analyses and their negative examples. To reach to the seven categories of standard NVH problems is relatively easy. By using negative examples of design selection, probability of choosing right standard NVH design from more than 40 options will be improved. Further, better qualitative performance prediction will help obtaining a right particular NVH solution.

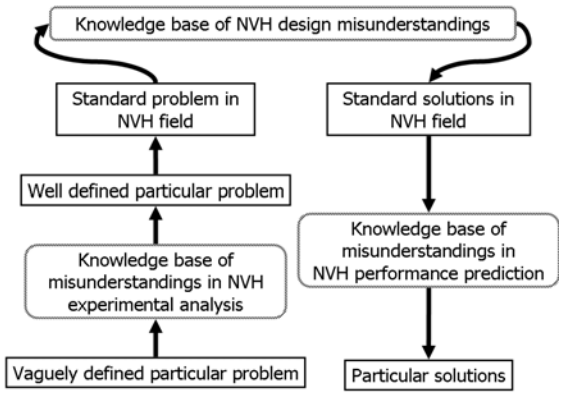

Fig. 1 Improving TRIZ process for solving NVH problems by adding negative examples

The negative examples will be projected on a screen at the symposium, but only part of it will be printed in the proceedings.