

A FRONT-END LUMPED-PARAMETER APPROACH TO PLANNING PHYSICAL ROBUST ENGINEERING DESIGN EXPERIMENTS ON MANUFACTURED DYNAMIC DEVICES

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Abstract

There are four fields which are obligatory (Purpose, Design, Findings and Value)

PURPOSE What are the reason(s) for making the presentation or the aims of the research?

This presentation will focus on how to use a lumped-parameter analysis to prioritise the design factors to be included in physical robust engineering design (RED) experiments on dynamic devices, particularly where the design factor values will be dictated by as-built assemblies selected from the production line.

FINDINGS What was found in the course of the work? This will refer to analysis, discussion, or results.

It is shown that planning RED experiments on dynamic devices is helped by combining analysis of invariant groups, system equations and causal insight from bond graph models.

If research is reported in the presentation, this section must be completed and should include suggestions for future research and any identified limitations in the research process.

What outcomes and implications for practice, applications and consequences are identified? Not all presentations will have practical implications but most will. What changes to practice should be made as a result of this research/presentation?

This analytical approach will inform the configuration of simulation models for RED on lumped-parameter dynamic systems in terms of output response and representation of manufacturing variability. In addition, it provides a framework for dealing with design factor levels that are difficult to configure as orthogonal design factor level design experiments due to their manufactured values being dictated by the particular assembly build.

VALUE What is new in the intended presentation? State the value of the presentation and to whom.

Using invariant groups to identify dynamically similarity in the context of dynamic devices provides the RED practitioner with a means of conducting physical experiments with manufactured assemblies, which will also be of value when validating simulation models in RED experiments.

DESIGN How are the objectives achieved? Include the main method(s) used for the research. What is the approach to the topic and what is the theoretical or subject scope of the presentation?

Bond graphs and dimensional analysis are the main analytical methods used to gain insight into the dynamic device. The system matrix of the device is formulated and used to assess the role of the design factors. Invariant groups are identified from dimensional analysis to determine a suitable output measure(s) for simulation and also to identify pairs of devices that have dynamic similarity. This front-end RED approach is applied to lumped-parameter dynamic systems.

Keywords: *Robust Engineering Design, lumped-parameter model, invariant groups, bond graph, system equations, parameter estimates*