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Plastic Tuners for Power Steering Pump Noise Reduction

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Abstract

Tuning cables of various designs are commonly included in automotive power steering systems to reduce the undesirable effects of pressure pulsations generated in the power steering pump. A recent development which has the potential to reduce noise is the plastic tuner (PT). The main benefit of this device when compared with the existing spiral wound steel tuner (SWST) is the vastly reduced cost associated with the methods of manufacturing.

Despite the apparent attractiveness of such a device, the PT has not been widely implemented by automotive fluid system suppliers. The main reason is relatively little is known about the performance of these devices and indeed their comparative performance with respect to a SWST. This research seeks to address this issue by developing a better understanding of the PT using experimental and analytical techniques to examine the acoustic noise reduction mechanisms of a variety of PT designs.

This thesis examines the relevant literature associated with the subject and covers several noise reduction techniques that can be applied to this research. The literature review section highlights a general gap in the knowledge base, where little specific detail exists that has not been derived experimentally from SWSTs. As such the general aim of this research is to further the knowledge into PTs, investigate the significant parameters of PT designs, and generate a suitable system model. The methodology proposed to achieve these aims is explained in detail and experimental and theoretical approaches are outlined. Finally, conclusions derived from the experimental investigations are discussed and a comparison is drawn between experimental and predicted results. For all PT parameters evaluated, good agreement is illustrated between predicted and experimental results.

Statement of Originality

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Jamie Wilkie and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Jamie Wilkie

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I would like to thank Cooper Standard Automotive and in particular Troy Kelly for assistance with my experiments. The un-foreseen plant closure drastically impacted my research plans and without his help in setting up, dismantling, re-assembling, cups of tea etc., the full experimental schedule may not have been possible in the time available.

I am also thankful to the University Electronics Laboratory, for the use of their equipment, and in particular to Silvio De Ieso for his assistance in the early stages.

Finally, I would like to thank my family and close friends for their support over the last few years. I didn't anticipate the demands that this project would thrust upon me or the twists and turns my life would take along the way. Thanks for the understanding and for giving me the strength to keep going.

This thesis is dedicated to my son Innes. I hope it inspires you to be everything you can be.

Research Background

It should be noted that a significant portion of this research, specifically the experimental phase, was conducted whilst the author was an employee of Cooper Standard Automotive (CSA), Woodville North, Adelaide. CSA very kindly granted access to their power steering noise tuning rig as well as data acquisition software. In addition, a number of the test samples as well as baseline comparison samples were derived from CSA products. As a consequence, this research contains some context which has been deemed to be commercially sensitive, and hence, CSA have requested that no journal or conference papers associated with this research be published at this time. It is hoped that the outcomes from this research will be able to be published in the future, once sufficient intellectual property protection is in place.

In mid 2008 CSA closed their manufacturing facility in Adelaide and as a consequence, the scope of the experimental phase was constrained. Furthermore, considering the phase of the project at that time (approximately half-way through), it was difficult to predict future outcomes that may require further experimental investigation. To reduce this impact, the author completed a series of final experiments in the lead-up to the closure, in an effort to capture as much data as possible before the experimental facility was dismantled. This approach proved very useful upon reflection, and has contributed to some of the main outcomes derived in this thesis.

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