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Home
Submit Final Paper
Submit Abstract
Paper Status
Publication Schedule
View Abstracts
Technical Tracks
Author Resources
Indexing
Organizers
Help
Logout

Paper Details

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IMECE2016-66497 (Status: Draft paper accepted , Copyright received) **Schedule:**
Analysing a Design and Technology Development Framework Through the Implementation of a Prototype Composite Vehicle Suspension System

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Authors

Name	Company	Author Order	Role	Copyright Received
Mr. Warren Hurter	University of Johannesburg	1	Contact Presentation and Lead Author	23 Jun 2016
Mrs. Nickey Janse van Rensburg	The University of Johannesburg	2	Co-Author	23 Jun 2016
Mr. Daniel Madyira	The University of Johannesburg	3	Co-Author	21 Jun 2016

Track 15 Systems, Design, and Complexity

Name	Company	Phone & Fax	Role
Dr. Cameron Turner	Clemson University	P:1111111111	Track Organizer

Topic: 15-7 Product and Process Design

Name	Company	Phone & Fax	Role
Dr. Shuichi Fukuda	Keio University	P:XXX-XXX-XXXX	Topic Organizer

Session: 15-7-1

Abstract

A uniquely configured vehicle suspension system, manufactured primarily of lightweight composite materials, is required for the University of Johannesburg's Solar Powered race vehicle. For this design to reach successful completion, an assessment framework is needed that would scrutinise and analyse every phase of the development. Therefore, the focus is on the design and development of a prototype composite vehicle suspension system and the framework implemented to control the research and development process. The National Aeronautics and Space Administration (NASA), as well as Departments of Defence and Energy in the United States of America, have established a technology assessment model known as a "Technology Readiness Assessment" (TRA). The purpose of this assessment model is to identify those elements and processes of technology development that are considered critical to ensuring the intended operation of the system is reached, and ultimately that the project is a success. The Technology Readiness Assessment (TRA) can be viewed as an expansion on the scientific method, with an hypothesis tested and communicated results then taken further to be implemented on a demonstration platform and final system [10]. The TRA assessment comprises of various technology readiness levels (TRL), which are an indication of the progress level or maturity of a technology element, with the TRL scale ranging from 1 (basic principles observed) through to 9 (the total system has been used successfully in project operations). Beginning with the lowest level of technology readiness (TRL 1), the problem background will be summarised, and design requirements as well as parameters formulated based on both design goals and competitive platform safety regulations for a new vehicle suspension design. This is followed by a literature review focusing on suspension, steering and braking design theory as well as advanced composites. Once the relevant theory and summarised design requirements are in place, the design concepts can be generated and finalised based on these requirements, which will allow for the eventual complete computer aided design (CAD) model of the system to be created. This constitutes a TRL 2 level assessment, with the primary deliverable being a complete CAD model and the identification of critical technology elements or "at risk" design elements that require further investigation and validation prior to their respective inclusion in the final system. These "at risk" elements will then form the basis of the experimental programme. For the various composite components required in the lightweight suspension system, the TRL 3 assessment has been modified to incorporate the development of manufacturing processes. In primarily making use of a resin infusion composite processing technique, an accurate and repeatable procedure is needed for component development and in order to create samples required for laboratory scale and relevant environmental testing. Laboratory scale testing (TRL 4) comprises of three experiments based on known ISO and ASTM standards, while relevant environmental (in-service application) experiments (TRL 5) comprises of four designed static load tests for component validation. Once the "at risk" components have been validated, they are integrated into the final assembly, in preparation for static system evaluation (TRL 6). Low speed (TRL 7) and high speed (TRL 8) testing of the vehicle as a system-commissioning phase. For final system operation, the suspension assembly will be assessed when implemented into a solar powered vehicle, to compete in the 2014 Sasol

Solar Challenge. This is an international cross-country competitive endurance event spanning the length and breadth of South Africa (over 2000 km). Additionally the vehicle will be the main showpiece in the 2015 African Solar Drive. A 4000 km event spanning parts of South Africa, Namibia and Botswana. Finally, the Technology Readiness Assessment framework will be analysed and reformulated as needed to better suit future technology development requirements for a composite suspension system.

Presentation Author Biography

Warren Hurter has a Master's Degree in Mechanical Engineering and has been involved in the building of solar powered cars since 2011 at UJ. He now supports the Research and Projects Office through Research and Development Initiatives as a consulting engineer.

Reviewer Comments

Reviewer 1:
A really interesting paper. It is the first time I have seen TRL levels applied to a design process in a student competition. Very interesting.
The format of the paper seems to change dramatically about page 5. Please see the ASME format guidelines.
Also, many of the figures are really too small. Please make the figures larger.
Nice paper.

Reviewer 2:
In this paper, the authors present a very interesting topic about a new concept solar power car made of light weight composite materials. The design overview was introduced. A series of tests including composite tubing test, structural adhesive test, low and high speed test etc. were implemented. The quality of writing and organization of the paper is great. This work is of significant novelty and commercialism. My recommendation is acceptable. There are a couple of suggestions from the reviewer: 1) The authors should check the line width and paragraph width carefully. Also, the font colors are not uniform. 2) Page 6: The title of table 3 is rotating bending bar test. But the unit of load is kg (force) instead of torque. Please clarify. 3) For low speed and high speed test (TRL7 and 8), are there any criteria? The authors may add more details including how long the tests last.

Draft Recommendations/Comments

Comments
Congratulations. Your paper has been accepted to IMECE2016 in Phoenix. Please use the comments of the reviewers to improve your paper prior to final submission. See you at the conference.

Status

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