Modular Vehicle Design Concept

Timothy J. Rue

Thesis submitted to the Faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science in Engineering Mechanics

Alfred L. Wicks, Chair
Scott W. Case
Mark S. Cramer

November 18, 2014
Blacksburg, Virginia

Keywords: Hybrid-Electric Vehicle, Autonomy, Wheel Hub Motors, Vehicle Concept, Logistics Demand Reduction, Expeditionary Power, Silent Operation, Batteries, Solid Oxide Fuel Cells, Structural Health Monitoring, Energy Harvesting Shock Absorbers, Non-pneumatic Tires, Protection from Electromagnetic Pulses, Drive by Wire, ITV, Vehicle Bounds, Mean Maximum Pressure, Advanced Mobility, M29 Weasel, TPz Fuchs, Jeep, Polaris
Copyright 2014, Timothy J. Rue
<table>
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<tr>
<th>Name</th>
<th>Timothy Rue</th>
</tr>
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<tr>
<td>Job Title</td>
<td>Research Assistant</td>
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<tr>
<td>Institution</td>
<td>Virginia Tech</td>
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<td>Title of Work Used</td>
<td>2 DOF diagram</td>
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<td>Copyright Holder</td>
<td>Anderson, Martyn Harty, Damian</td>
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<td>Publisher</td>
<td>10th International Symposium on Advanced Vehicle …</td>
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<td>A diagram showing a two degree of freedom SMD system.</td>
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<td>Date of Evaluation</td>
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Describe the **Purpose** and Character of Your Intended Use:

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[+] Use is not-for-profit
[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)
[+] Use is one-time, or is only occasional or spontaneous
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-[+] Work to be used contains limited new knowledge, content, or creative expression (in relation to previously copyrighted works)
-[+] Work to be used is primarily of a factual nature (non-fiction, collection of facts, etc.)

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-[+] The portion used is not the “heart” of the work (the portion considered most central to the work as a whole)

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The Average "Fairness Level," Based on Your Rating of Each of the 4 Factors, Is:

[see tool disclaimer for important clarifying information]:

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Based on the information and justification I have provided above, I, Timothy Rue, am asserting this use is FAIR under Section 107 of the U.S. Copyright Code.

Signature: _____________________________________________

Date of Signature: ________________________________

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<tr>
<td>Title of Work Used:</td>
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Name: Timothy Rue  
Job Title: Research Assistant  
Institution: Virginia Tech  
Title of Work Used: British SAS on a Jeep  
Copyright Holder: David Stubblebine  
Publication Status: Published  
Publisher: World War Two Database  
Place of Publication: Online  
Publication Year: 2014  
Description of Work: British SAS on a jeep in north Africa during WWII.  
Date of Evaluation: December 1, 2014  
Date of Intended Use: December 1, 2014

Describe the **Purpose** and Character of Your Intended Use:

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<td>Title of Work Used:</td>
<td>Characteristics of Various Technologies/Types of batteries for use in vehicle applications</td>
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<td>A table comparing batteries for vehicle applications.</td>
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Name: Timothy Rue  
Job Title: Research Assistant  
Institution: Virginia Tech  
Title of Work Used: Comparison performance between existing battery type  
Copyright Holder: Sutopo, W. Maryanie, D. I. Purwanto, A. Nizam, M.  
Publication Status: Published  
Publisher: 2013 Joint International Conference on Rural Information & Communication Technology and Electric-Vehicle Technology (rICT & ICeV-T)  
Place of Publication: Online  
Publication Year: 2013  
Description of Work: A table showing the comparison of different battery types  
Date of Evaluation: December 1, 2014  
Date of Intended Use: December 1, 2014

Describe the **Purpose** and Character of Your Intended Use:

- [+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"
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<table>
<thead>
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<th>Fair</th>
<th>Unfair</th>
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<td><img src="https://i.imgur.com/123.png" alt="Fair" /></td>
<td><img src="https://i.imgur.com/456.png" alt="Unfair" /></td>
</tr>
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Page 1
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Name: Timothy Rue
Job Title: Research Assistant
Institution: Virginia Tech
Title of Work Used: DIDS System Concept
Copyright Holder: Richards, W Lance Madaras, Eric Prosser, William H Studor, George
Publication Status: Published
Publisher: NASA
Place of Publication: Online
Publication Year: 2013
Description of Work: Accelerometers triangulating position of impact
Date of Evaluation: December 1, 2014
Date of Intended Use: December 1, 2014

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[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"
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<tr>
<td><strong>Institution:</strong></td>
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<td>Efficiency for WHM</td>
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<td><strong>Copyright Holder:</strong></td>
<td>Freitag, Gunter Klopzig, Markus Schleicher, Klaus Wilke, Markus Schramm, Marco</td>
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<td><strong>Publication Status:</strong></td>
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<td><strong>Publication Year:</strong></td>
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Name: Timothy Rue
Job Title: Research Assistant
Institution: Virginia Tech
Title of Work Used: Google Car
Copyright Holder: Darrell Etherington
Publication Status: Published
Publisher: Tech Crunch
Place of Publication: Online
Publication Year: 2014
Description of Work: The Oshkosh Terramax
Date of Evaluation: December 1, 2014
Date of Intended Use: December 1, 2014

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Name: Timothy Rue  
Job Title: Research Assistant  
Institution: Virginia Tech  
Title of Work Used: Integrated Design Procedures for system reliability  
Copyright Holder: Isermann, R. Schwarz, R. Stolzl, S.  
Publication Status: Published  
Publisher: IEEE Control Systems Magazine  
Place of Publication: Online  
Publication Year: 2002  
Description of Work: Flow chart for achieving system reliability  
Date of Evaluation: December 1, 2014  
Date of Intended Use: December 1, 2014

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**Name:** Timothy Rue  
**Job Title:** Research Assistant  
**Institution:** Virginia Tech  
**Title of Work Used:** Internal workings of a wheel hub motor  
**Copyright Holder:** Ifedi, Chukwuma J. Mecrow, Barrie C. Brockway, Simon T. M. Boast, Gerard S. Atkinson, Glynn J. Kostic-Perovic, Dragica  
**Publication Status:** Published  
**Publisher:** IEEE  
**Place of Publication:** Online  
**Publication Year:** 2013  
**Description of Work:** A diagram showing the internal workings of a wheel hub motor.  
**Date of Evaluation:** December 1, 2014  
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Based on the information and justification I have provided above, I, Timothy Rue, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: _______________________________________

Date of Signature: _______________________________

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<thead>
<tr>
<th><strong>Name:</strong></th>
<th>Timothy Rue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job Title:</strong></td>
<td>Research Assistant</td>
</tr>
<tr>
<td><strong>Institution:</strong></td>
<td>Virginia Tech</td>
</tr>
<tr>
<td><strong>Title of Work Used:</strong></td>
<td>Li-ion rechargeable battery</td>
</tr>
<tr>
<td><strong>Copyright Holder:</strong></td>
<td>Marshall Brian</td>
</tr>
<tr>
<td><strong>Publication Status:</strong></td>
<td>Published</td>
</tr>
<tr>
<td><strong>Publisher:</strong></td>
<td>How Stuff Works</td>
</tr>
<tr>
<td><strong>Place of Publication:</strong></td>
<td>Online</td>
</tr>
<tr>
<td><strong>Publication Year:</strong></td>
<td>2013</td>
</tr>
<tr>
<td><strong>Description of Work:</strong></td>
<td>A diagram showing the chemistry of a Li-ion battery</td>
</tr>
<tr>
<td><strong>Date of Evaluation:</strong></td>
<td>December 1, 2014</td>
</tr>
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Describe the **Purpose** and Character of Your Intended Use:

[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"

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![Fair](✔️) ![Unfair](☐)

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![Fair](✔️) ![Unfair](☐)

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Name: Timothy Rue
Job Title: Research Assistant
Institution: Virginia Tech
Title of Work Used: M29 Weasel
Copyright Holder: Margaret Bourke-White
Publication Status: Published
Publisher: Time
Place of Publication: Magazine
Publication Year: 1945
Description of Work: Us Fifth Army In Italy Amer. 10th Mountain Div. Army ski patrol, riding in a snow buggy, on the Italian front in the Apennine Mountains.
Date of Evaluation: December 1, 2014
Date of Intended Use: December 1, 2014

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Fair  ✔  ✗  ✗  ✗  ✗  ✗  Unfair

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Fair  ✔  ✔  ✔  ✗  ✗  ✗  Unfair

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Fair  ✔  ✔  ✔  ☐  ☐  ☐  Unfair
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Name: Timothy Rue
Job Title: Research Assistant
Institution: Virginia Tech
Title of Work Used: Military Truck
Copyright Holder: Guenter Hohl
Publication Status: Published
Publisher: Journal of Terramechanics
Place of Publication: Online
Publication Year: 2007
Description of Work: Diagram of the engine and drive train in a military truck.
Date of Evaluation: December 1, 2014
Date of Intended Use: December 1, 2014

Describe the Purpose and Character of Your Intended Use:

[✓] Use is for “criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research”
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Fair Use Evaluation Documentation

Compiled using the Fair Use Evaluator [cc] 2008 Michael Brewer & the Office for Information Technology Policy, http://librarycopyright.net/fairuse/
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- [x] Work to be used has been previously PUBLISHED
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Fair ☑️aits Unfair

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Signature: ____________________________

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### Name: Timothy Rue

### Job Title: Research Assistant

### Institution: Virginia Tech

### Title of Work Used: MULE

### Copyright Holder: Defense Update

### Publisher: Defense Update

### Place of Publication: Online

### Publication Year: 2007

### Description of Work: MULE showing shoulder joint mobility.

### Date of Evaluation: December 1, 2014

### Date of Intended Use: December 1, 2014

**Describe the Purpose and Character of Your Intended Use:**

[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"

[+] Use is not-for-profit

[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)

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<th></th>
<th>Unfair</th>
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<td>Virginia Tech</td>
</tr>
<tr>
<td>Title of Work Used:</td>
<td>Oshkosh Terramax</td>
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<tr>
<td>Copyright Holder:</td>
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<td>Publication Status:</td>
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<td>Description of Work:</td>
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<td>Date of Evaluation:</td>
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Describe the **Purpose** and Character of Your Intended Use:

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---

**Name:** Timothy Rue  
**Job Title:** Research Assistant  
**Institution:** Virginia Tech  
**Title of Work Used:** Solid Oxide Fuel Cell  
**Copyright Holder:** Earnest Garrison  
**Publication Status:** Published  
**Publisher:** Earnest Garrison  
**Place of Publication:** Online  
**Publication Year:** 2014  
**Description of Work:** A diagram of the chemistry behind SOFCs  
**Date of Evaluation:** December 1, 2014  
**Date of Intended Use:** December 1, 2014
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

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</tr>
<tr>
<td>Title of Work Used:</td>
<td>TPz Fuchs</td>
</tr>
<tr>
<td>Copyright Holder:</td>
<td>Military Today</td>
</tr>
<tr>
<td>Publication Status:</td>
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Name: Timothy Rue
Job Title: Research Assistant
Institution: Virginia Tech
Title of Work Used: Tradeoffs between lithium-ion battery technologies
Copyright Holder: Sutopo, W. Maryanie, D. I. Purwanto, A. Nizam, M.
Publication Status: Published
Publisher: 2013 Joint International Conference on Rural Information & Communication Technology and Electric-Vehicle Technology (rICT & ICeV-T)
Place of Publication: Online
Publication Year: 2013
Description of Work: A diagram showing the comparison of different li-ion battery types
Date of Evaluation: December 1, 2014
Date of Intended Use: December 1, 2014

Describe the Purpose and Character of Your Intended Use:

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