

VTool: A Method for Predicting and Understanding the Energy Flow and Losses in Advanced Vehicle Powertrains

Robert Jesse Alley

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
Mechanical Engineering



Chair: Douglas J. Nelson
Robert L. West
Scott T. Huxtable

June 15, 2012
Blacksburg, VA

Keywords: hybrid electric vehicle, plug-in hybrid electric vehicle, electric vehicle, environment, greenhouse gases, petroleum, fuel economy, powertrain modeling

Copyright 2012, R. Jesse Alley

The permission included after this page for the reproduction of figures from the Elsevier Journal in this thesis applies to Figures 4 and 5.

**ELSEVIER LICENSE
TERMS AND CONDITIONS**

Apr 17, 2012

This is a License Agreement between Robert J Alley ("You") and Elsevier ("Elsevier") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by Elsevier, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

Supplier	Elsevier Limited The Boulevard, Langford Lane Kidlington, Oxford, OX5 1GB, UK
Registered Company Number	1982084
Customer name	Robert J Alley
Customer address	2512 Plymouth Dr. Blacksburg, VA 24060
License number	2891491490624
License date	Apr 17, 2012
Licensed content publisher	Elsevier
Licensed content publication	Transportation Research Part C: Emerging Technologies
Licensed content title	Electric vehicles: How much range is required for a day's driving?
Licensed content author	Nathaniel S. Pearre, Willett Kempton, Randall L. Guensler, Vetri V. Elango
Licensed content date	December 2011
Licensed content volume number	19
Licensed content issue number	6
Number of pages	14
Start Page	1171
End Page	1184
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	2
Format	both print and electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No

Order reference number

Title of your thesis/dissertation VTool: A Method for Predicting and Understanding the Energy Flow and Losses in Advanced Vehicle Powertrains

Expected completion date May 2012

Estimated size (number of pages) 150

Elsevier VAT number GB 494 6272 12

Permissions price 0.00 USD

VAT/Local Sales Tax 0.0 USD / 0.0 GBP

Total 0.00 USD

Terms and Conditions

INTRODUCTION

1. The publisher for this copyrighted material is Elsevier. By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the Billing and Payment terms and conditions established by Copyright Clearance Center, Inc. ("CCC"), at the time that you opened your Rightslink account and that are available at any time at <http://myaccount.copyright.com>).

GENERAL TERMS

2. Elsevier hereby grants you permission to reproduce the aforementioned material subject to the terms and conditions indicated.

3. Acknowledgement: If any part of the material to be used (for example, figures) has appeared in our publication with credit or acknowledgement to another source, permission must also be sought from that source. If such permission is not obtained then that material may not be included in your publication/copies. Suitable acknowledgement to the source must be made, either as a footnote or in a reference list at the end of your publication, as follows:

“Reprinted from Publication title, Vol /edition number, Author(s), Title of article / title of chapter, Pages No., Copyright (Year), with permission from Elsevier [OR APPLICABLE SOCIETY COPYRIGHT OWNER].” Also Lancet special credit - “Reprinted from The Lancet, Vol. number, Author(s), Title of article, Pages No., Copyright (Year), with permission from Elsevier.”

4. Reproduction of this material is confined to the purpose and/or media for which permission is hereby given.

5. Altering/Modifying Material: Not Permitted. However figures and illustrations may be altered/adapted minimally to serve your work. Any other abbreviations, additions, deletions and/or any other alterations shall be made only with prior written authorization of Elsevier Ltd. (Please contact Elsevier at permissions@elsevier.com)

6. If the permission fee for the requested use of our material is waived in this instance, please be advised that your future requests for Elsevier materials may attract a fee.

7. **Reservation of Rights:** Publisher reserves all rights not specifically granted in the combination of (i) the license details provided by you and accepted in the course of this licensing transaction, (ii) these terms and conditions and (iii) CCC's Billing and Payment terms and conditions.
8. **License Contingent Upon Payment:** While you may exercise the rights licensed immediately upon issuance of the license at the end of the licensing process for the transaction, provided that you have disclosed complete and accurate details of your proposed use, no license is finally effective unless and until full payment is received from you (either by publisher or by CCC) as provided in CCC's Billing and Payment terms and conditions. If full payment is not received on a timely basis, then any license preliminarily granted shall be deemed automatically revoked and shall be void as if never granted. Further, in the event that you breach any of these terms and conditions or any of CCC's Billing and Payment terms and conditions, the license is automatically revoked and shall be void as if never granted. Use of materials as described in a revoked license, as well as any use of the materials beyond the scope of an unrevoked license, may constitute copyright infringement and publisher reserves the right to take any and all action to protect its copyright in the materials.
9. **Warranties:** Publisher makes no representations or warranties with respect to the licensed material.
10. **Indemnity:** You hereby indemnify and agree to hold harmless publisher and CCC, and their respective officers, directors, employees and agents, from and against any and all claims arising out of your use of the licensed material other than as specifically authorized pursuant to this license.
11. **No Transfer of License:** This license is personal to you and may not be sublicensed, assigned, or transferred by you to any other person without publisher's written permission.
12. **No Amendment Except in Writing:** This license may not be amended except in a writing signed by both parties (or, in the case of publisher, by CCC on publisher's behalf).
13. **Objection to Contrary Terms:** Publisher hereby objects to any terms contained in any purchase order, acknowledgment, check endorsement or other writing prepared by you, which terms are inconsistent with these terms and conditions or CCC's Billing and Payment terms and conditions. These terms and conditions, together with CCC's Billing and Payment terms and conditions (which are incorporated herein), comprise the entire agreement between you and publisher (and CCC) concerning this licensing transaction. In the event of any conflict between your obligations established by these terms and conditions and those established by CCC's Billing and Payment terms and conditions, these terms and conditions shall control.
14. **Revocation:** Elsevier or Copyright Clearance Center may deny the permissions described in this License at their sole discretion, for any reason or no reason, with a full refund payable to you. Notice of such denial will be made using the contact information provided by you. Failure to receive such notice will not alter or invalidate the denial. In no event will Elsevier or Copyright Clearance Center be responsible or liable for any costs, expenses or damage incurred by you as a result of a denial of your permission request, other than a refund of the amount(s) paid by you to Elsevier and/or Copyright Clearance Center for denied permissions.

LIMITED LICENSE

The following terms and conditions apply only to specific license types:

15. Translation: This permission is granted for non-exclusive world **English** rights only unless your license was granted for translation rights. If you licensed translation rights you may only translate this content into the languages you requested. A professional translator must perform all translations and reproduce the content word for word preserving the integrity of the article. If this license is to re-use 1 or 2 figures then permission is granted for non-exclusive world rights in all languages.

16. Website: The following terms and conditions apply to electronic reserve and author websites:
Electronic reserve: If licensed material is to be posted to website, the web site is to be password-protected and made available only to bona fide students registered on a relevant course if:

This license was made in connection with a course,

This permission is granted for 1 year only. You may obtain a license for future website posting,

All content posted to the web site must maintain the copyright information line on the bottom of each image,

A hyper-text must be included to the Homepage of the journal from which you are licensing at <http://www.sciencedirect.com/science/journal/xxxxx> or the Elsevier homepage for books at <http://www.elsevier.com> , and

Central Storage: This license does not include permission for a scanned version of the material to be stored in a central repository such as that provided by Heron/XanEdu.

17. Author website for journals with the following additional clauses:

All content posted to the web site must maintain the copyright information line on the bottom of each image, and

the permission granted is limited to the personal version of your paper. You are not allowed to download and post the published electronic version of your article (whether PDF or HTML, proof or final version), nor may you scan the printed edition to create an electronic version,

A hyper-text must be included to the Homepage of the journal from which you are licensing at <http://www.sciencedirect.com/science/journal/xxxxx> , As part of our normal production process, you will receive an e-mail notice when your article appears on Elsevier's online service ScienceDirect (www.sciencedirect.com). That e-mail will include the article's Digital Object Identifier (DOI). This number provides the electronic link to the published article and should be included in the posting of your personal version. We ask that you wait until you receive this e-mail and have the DOI to do any posting.

Central Storage: This license does not include permission for a scanned version of the material to be stored in a central repository such as that provided by Heron/XanEdu.

18. Author website for books with the following additional clauses:

Authors are permitted to place a brief summary of their work online only.

A hyper-text must be included to the Elsevier homepage at <http://www.elsevier.com>

All content posted to the web site must maintain the copyright information line on the bottom of each image

You are not allowed to download and post the published electronic version of your chapter, nor

may you scan the printed edition to create an electronic version.

Central Storage: This license does not include permission for a scanned version of the material to be stored in a central repository such as that provided by Heron/XanEdu.

19. **Website** (regular and for author): A hyper-text must be included to the Homepage of the journal from which you are licensing at <http://www.sciencedirect.com/science/journal/xxxxx>. or for books to the Elsevier homepage at <http://www.elsevier.com>

20. **Thesis/Dissertation**: If your license is for use in a thesis/dissertation your thesis may be submitted to your institution in either print or electronic form. Should your thesis be published commercially, please reapply for permission. These requirements include permission for the Library and Archives of Canada to supply single copies, on demand, of the complete thesis and include permission for UMI to supply single copies, on demand, of the complete thesis. Should your thesis be published commercially, please reapply for permission.

21. **Other Conditions**:

v1.6

If you would like to pay for this license now, please remit this license along with your payment made payable to "COPYRIGHT CLEARANCE CENTER" otherwise you will be invoiced within 48 hours of the license date. Payment should be in the form of a check or money order referencing your account number and this invoice number RLNK500762441. Once you receive your invoice for this order, you may pay your invoice by credit card. Please follow instructions provided at that time.

Make Payment To:
Copyright Clearance Center
Dept 001
P.O. Box 843006
Boston, MA 02284-3006

For suggestions or comments regarding this order, contact RightsLink Customer Support: customercare@copyright.com or +1-877-622-5543 (toll free in the US) or +1-978-646-2777.

Gratis licenses (referencing \$0 in the Total field) are free. Please retain this printable license for your reference. No payment is required.

Fair Use Analysis for Pearre, Figure 5 and Figure 6

This appendix contains the fair use analysis conducted using the University of Minnesota's 'Thinking Through Fair Use' tool (<https://www.lib.umn.edu/copyright/fairthoughts>). Everything in this appendix was copied directly from the website quoted in previously.

Your Fair Use Analysis

Work considered: Pearre, N.S., et al., (2011), "Electric vehicles: How much range is required for a day's driving?," Transportation Research Part C: Emerging Technologies, Vol. 19, Issue 6, Dec. 2011, pp. 1171-1184.

Date: 06-18-2012

Here's your "Thinking Through Fair Use" results! As a reminder, these results have not been analyzed or processed in any way, except to format the input you provided into one document. These results don't claim to tell you whether a proposed use is fair or not, and do not constitute legal advice. For formal legal advice, please contact an attorney.

You thought that **purpose** was *strongly favorable* towards fair use.

You highlighted these elements as relevant to your proposed use:

Favors Fair Use

Weighs Against Fair Use

Educational, scholarly, and research uses,
and/or news reporting

Notes: Used only to give background supporting background research to thesis topic.

You thought that **nature** was *strongly favorable* towards fair use.

You highlighted these elements as relevant to your proposed use:

Favors Fair Use

Weighs Against Fair Use

Published source
Factual or non-fiction source

Notes: Published in an factual, non-fiction academic journal

You thought that **amount** was *strongly favorable* towards fair use.

You highlighted these elements as relevant to your proposed use:

Favors Fair Use

Weighs Against Fair Use

Proportionally small excerpt, extract, or clip
Portion used is peripheral or not significant to the entire work
Only as much as absolutely necessary for a favored purpose

You thought that **market** was *somewhat favorable* towards fair use.

You highlighted these elements as relevant to your proposed use:

Favors Fair Use

Weighs Against Fair Use

User owns lawful copy of the work (bought or otherwise legitimately acquired)
Use stimulates market for original work
No way to pay or seek permission for your use

Easy to redistribute, or to make additional copies of the product of your use (i.e. digital file, online use)

When looking over your results, remember that **no single factor is decisive** of fair use. There also **may be other relevant considerations**, specific to your use, that do not appear in the results from this general-purpose tool. Many considerations are relevant, and only by looking at the whole picture, across all the issues, can you make a reasonable guess about whether your use is fair or not!