

# Numerical Analysis of the Bat Noseleaf Dynamics and its Impact on the Encoding of Sensory Information

Anupam K. Gupta

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

Doctor of Philosophy  
in  
Mechanical Engineering

Rolf Müller, Chair  
Hongxiao Zhu  
James A. Simmons  
Javid Bayandor  
Ricardo A. Burdisso  
Shashank Priya

December 7, 2016  
Blacksburg, Virginia

Keywords: Numerical Analysis, Noseleaf Dynamics, Biosonar, Sensory Encoding  
Copyright 2016, Anupam K Gupta

# Public Library of Science (PLOS)

## Licenses and Copyright

**PLOS** applies the [Creative Commons Attribution \(CC BY\) license](#) to articles and other works we publish. If you submit your paper for publication by PLOS, you agree to have the CC BY license applied to your work. Under this Open Access license, you as the author agree that anyone can reuse your article in whole or part for any purpose, for free, even for commercial purposes. Anyone may copy, distribute, or reuse the content as long as the author and original source are properly cited. This facilitates freedom in re-use and also ensures that PLOS content can be mined without barriers for the needs of research.

See URL for details: <http://journals.plos.org/plosone/s/licenses-and-copyright>

## AIP PUBLISHING LLC LICENSE TERMS AND CONDITIONS

Nov 11, 2016

This Agreement between Anupam Kumar Gupta ("You") and AIP Publishing LLC ("AIP Publishing LLC") consists of your license details and the terms and conditions provided by AIP Publishing LLC and Copyright Clearance Center.

License Number	3986150737493
License date	Nov 11, 2016
Licensed Content Publisher	AIP Publishing LLC
Licensed Content Publication	The Journal of the Acoustical Society of America
Licensed Content Title	Interplay of lancet furrows and shape change in the horseshoe bat noseleaf
Licensed Content Author	Anupam K. Gupta,Dane Webster,Rolf Müller
Licensed Content Date	Nov 20, 2015
Licensed Content Volume Number	138
Licensed Content Issue Number	5
Type of Use	Thesis/Dissertation
Requestor type	Author (original article)
Format	Electronic
Portion	Figure/Table
Number of figures/tables	8
Title of your thesis / dissertation	Numerical analysis of the bat noseleaf dynamics and its impact on the encoding of sensory information
Expected completion date	Dec 2016
Estimated size (number of pages)	95
Requestor Location	Anupam Kumar Gupta 3600 Richmond Ln  BLACKSBURG, VA 24060 United States Attn: Anupam Kumar Gupta
Billing Type	Invoice
Billing Address	Anupam Kumar Gupta 3600 Richmond Ln

Print This Page

## **American Institute of Physics (AIP)**

### **Licenses and Copyright**

Authors will retain copyright to their articles but must agree to apply the [Creative Commons Attribution \(CC BY\)](#) license to their work. Under the terms of this license, no permission is required from the author(s) or publisher for members of the community to copy, distribute, transmit, or adapt the article content, provided that a proper, prominent and unambiguous attribution is given to the authors in a manner that makes clear that the materials are being reused under permission of a Creative Commons license.

See URLs for details: [https://publishing.aip.org/authors/rights-and-permissions#Creative Commons](https://publishing.aip.org/authors/rights-and-permissions#Creative%20Commons)

<http://scitation.aip.org/content/asa/journal/poma/19/1/10.1121/1.4800656>

## AIP PUBLISHING LLC LICENSE TERMS AND CONDITIONS

Nov 11, 2016

This Agreement between Anupam Kumar Gupta ("You") and AIP Publishing LLC ("AIP Publishing LLC") consists of your license details and the terms and conditions provided by AIP Publishing LLC and Copyright Clearance Center.

License Number	3986150518196
License date	Nov 11, 2016
Licensed Content Publisher	AIP Publishing LLC
Licensed Content Publication	The Journal of the Acoustical Society of America
Licensed Content Title	Interplay of lancet furrows and shape change in the horseshoe bat noseleaf
Licensed Content Author	Anupam K. Gupta,Dane Webster,Rolf Müller
Licensed Content Date	Nov 20, 2015
Licensed Content Volume Number	138
Licensed Content Issue Number	5
Type of Use	Thesis/Dissertation
Requestor type	Author (original article)
Format	Electronic
Portion	Excerpt (> 800 words)
Will you be translating?	No
Title of your thesis / dissertation	Numerical analysis of the bat noseleaf dynamics and its impact on the encoding of sensory information
Expected completion date	Dec 2016
Estimated size (number of pages)	95
Requestor Location	Anupam Kumar Gupta 3600 Richmond Ln  BLACKSBURG, VA 24060 United States Attn: Anupam Kumar Gupta
Billing Type	Invoice
Billing Address	Anupam Kumar Gupta 3600 Richmond Ln

BLACKSBURG, VA 24060  
United States  
Attn: Anupam Kumar Gupta

Total 0.00 USD

### Terms and Conditions

Acoustic Society of America -- Terms and Conditions: Permissions Uses

Acoustic Society of America ("ASA") hereby grants to you the non-exclusive right and license to use and/or distribute the Material according to the use specified in your order, on a one-time basis, for the specified term, with a maximum distribution equal to the number that you have ordered. Any links or other content accompanying the Material are not the subject of this license.

1. You agree to include the following copyright and permission notice with the reproduction of the Material: "Reprinted with permission from [FULL CITATION]. Copyright [PUBLICATION YEAR], Acoustic Society of America." For an article, the copyright and permission notice must be printed on the first page of the article or book chapter. For photographs, covers, or tables, the copyright and permission notice may appear with the Material, in a footnote, or in the reference list.
2. If you have licensed reuse of a figure, photograph, cover, or table, it is your responsibility to ensure that the material is original to ASA and does not contain the copyright of another entity, and that the copyright notice of the figure, photograph, cover, or table does not indicate that it was reprinted by ASA, with permission, from another source. Under no circumstances does ASA, purport or intend to grant permission to reuse material to which it does not hold copyright.
3. You may not alter or modify the Material in any manner. You may translate the Material into another language only if you have licensed translation rights. You may not use the Material for promotional purposes. ASA reserves all rights not specifically granted herein.
4. The foregoing license shall not take effect unless and until ASA or its agent, Copyright Clearance Center, receives the Payment in accordance with Copyright Clearance Center Billing and Payment Terms and Conditions, which are incorporated herein by reference.
5. ASA or the Copyright Clearance Center may, within two business days of granting this license, revoke the license for any reason whatsoever, with a full refund payable to you. Should you violate the terms of this license at any time, ASA, Acoustic Society of America, or Copyright Clearance Center may revoke the license with no refund to you. Notice of such revocation will be made using the contact information provided by you. Failure to receive such notice will not nullify the revocation.
6. ASA makes no representations or warranties with respect to the Material. You agree to indemnify and hold harmless ASA, Acoustic Society of America, and their officers, directors, employees or agents from and against any and all claims arising out of your use of the Material other than as specifically authorized herein.
7. The permission granted herein is personal to you and is not transferable or assignable without the prior written permission of ASA. This license may not be amended except in a writing signed by the party to be charged.
8. If purchase orders, acknowledgments or check endorsements are issued on any forms containing terms and conditions which are inconsistent with these provisions, such inconsistent terms and conditions shall be of no force and effect. This document, including the CCC Billing and Payment Terms and Conditions, shall be the entire agreement between the parties relating to the subject matter hereof.

This Agreement shall be governed by and construed in accordance with the laws of the State of New York. Both parties hereby submit to the jurisdiction of the courts of New York County for purposes of resolving any disputes that may arise hereunder.

**Questions? [customer@copyright.com](mailto:customer@copyright.com) or +1-855-239-3415 (toll free in the US) or +1-978-646-2777.**