

**Request for Proposals
GUIDe Consortium
Duke Center for Aeromechanics**

Background

To address significant turbomachinery high cycle fatigue problems, Allison, Allied-Signal, General Electric, Pratt & Whitney, and Westinghouse joined with Carnegie Mellon University in 1991 to form a partnership - the GUIDe Consortium - that would result in improved technology for dealing with blade vibration problems. The acronym GUIDe stands for Government Agencies, Universities, and Industry working together to achieve a specific goal. The research sponsored by the Consortium is interdisciplinary in nature and requires research in the areas of structural and fluid mechanics. Guidance to the Consortium is provided by the Steering Committee, composed of representatives from the member companies and government. The Steering Committee sets research directions, evaluates proposals, and technically interacts with the researchers as their projects develop. The GUIDe Consortium Approach has three primary features:

- 1) Industry and government participation in the development of a nationally coordinated R & D program.
- 2) Active participation by industry and the government in evaluating the research and setting research directions.
- 3) Expediting the transfer of the resulting technology to industry.

The Air Force Research Laboratory (AFRL) and industry (currently Honeywell, Siemens, P&W, GE, Rolls-Royce, & Mitsubishi) are planning to execute the 4th edition of the GUIDe Consortium. GUIDe 4 is planned to be very similar to GUIDe 1, 2, and 3 with the exception that the GUIDe Center responsibility is moving from Carnegie Mellon University to Duke University. Release of this request for proposals is one of the first actions to form GUIDe 4.

Duke University is the legal entity that forms contractual agreements with industry, AFRL (through University Technologies Corporation and possibly other funding agencies), and the selected research institutions. It is expected that the funding will be approximately \$600K per year for 4 years, with a nearly equal split between AFRL and industry. The selection of proposals to be funded will be made in September 2007, but funding of most of these efforts is not expected to begin until January 2009. Following is detailed proposal information.

A draft of a software license agreement (SLA) is included as Appendix 2 with this RFP. This draft must be carefully reviewed by appropriate research institution officials. Your proposal must include a statement that software deliverables shall be available to all GUIDe Consortium members under a non-exclusive, royalty free software license agreement (see 3.f below). The SLA will be finalized in September 2007. If your proposal is selected, your research institution must agree to this final SLA (unmodified,

no negotiations) to receive funding. Please email any comments concerning this SLA to rkielb@duke.edu

Proposal Process Schedule (2007)

RFP Issued – July 10

Deadline for proposal submittal – midnight, August 27

Notification of proposal selection results – September 28

Detailed Proposal Information

- 1) Topics of Interest (Proposals should not be limited to those described below, nor should they simply echo these suggestions without significant detail)
 - a) Unsteady Aerodynamics
 - i) Rapid screening and design evaluation methods are needed to reduce the time and effort needed to perform aeromechanics calculations.
 - ii) The development of accurate and efficient interpolation/extrapolation schemes to minimize the number of CFD runs required to perform aeromechanics evaluations. These methods would allow advanced aeromechanics calculations to be performed early in the design phase thereby allowing potential response problems to be addressed when they are most easily fixed.
 - iii) Methods are needed to decrease overall CFD run times. In particular, the development of techniques that would reduce current computational times on the order of 100 times is of interest. These methods can include, but should not be limited to, development of novel approaches for efficient CFD calculations and/or Reduced Order Model (ROM) techniques. Reduction of computational time on this order would allow for the use of advanced aeromechanics techniques in probabilistic calculations. This capability would allow for the development of efficient robust blading design techniques.
 - iv) Approaches are needed to efficiently survey the operating range for aerodynamic instabilities, such as non-synchronous vibration (NSV), rotating stall, and flutter. The objective is to better characterize and understand the physical phenomena associated with highly separated flows in order to understand the role that shedding and rotating stall induced NSV play in the development of periodic forcing and aerodynamic damping. An understanding of this physics would allow for the critical areas on the operating map to be identified early in the design process. The designer would then be able to concentrate resources on reducing the response of the blade in these areas and not spend time looking for instabilities in other parts of the map.
 - v) Improved methods are need to conduct accurate efficient forced response analysis of higher order modes
 - vi) Studies are needed of the applicability of turbulence models for various flow regimes
 - vii) Improved methods are needed for flutter and response analysis of aerodynamically asymmetric (a.k.a. aerodynamic mistuning) configurations.

- viii) Studies are needed of multi-stage effects on flutter
- ix) Improved understanding is needed of the propagation of low engine order aerodynamic perturbations through multiple airfoil rows
- x) Advanced methods are needed to model the distortion produced and propagated by complex inlet arrangements
- xi) An experimental 3D standard configuration to benchmark industry and academic capability for both flutter and forced response is needed
- b) Advanced Damping
 - i) Ideas should extend beyond the traditional under-platform friction-type devices primarily used for fundamental blade modes, and focus on reducing dynamic stress in high order (complex bending) modes. The main interests include developing an understanding of the damping mechanism, analysis procedures for predicting the levels of damping and frequency effects, and appropriate experimental testing procedures. Important characteristics of the new technologies include minimization in the need to modify the base airfoil, operation across a wide temperature range, durability (including impact and erosion resistance), ability to withstand high g forces, and minimal intrusion to the aerodynamics
 - ii) Improved methods to measure damping on mistuned bladed disks and blisk is needed.
 - iii) Improved methods to determine the effective damper stiffness are needed.
- 2) Evaluation Criteria – The proposals will be evaluated with a strong emphasis on engineering relevance to current high cycle fatigue design issues and problems of the turbomachinery industry. Proposals that include clear defined, beneficial deliverables (intermediate and final) will receive high ranking. Likewise, software development that includes clearly defined methods for validation and verification will be given higher marks.
- 3) Required Format
 - a) Title sheet (See Appendix 1)
 - b) Introduction and Background
 - c) Technical Approach (including a time line showing tasks, subtasks, key milestones, & deliverables)
 - d) Benefits to Industry
 - e) Budget Request (budget breakdowns should be consistent with standard methods used in soliciting government funding)
 - f) Software License Agreement. The following software license statement must be included with your proposal. “The deliverable software described in the proposal shall be available to all GUIDe Consortium members under a non-exclusive, royalty free software license agreement. This draft software agreement included with this RFP has been reviewed by appropriate research institution officials.”
 - g) Statement of Authorization. The following statement of authorization must be included with your proposal, “This proposal, or parts of this proposal, may be incorporated by the GUIDe Consortium in proposal to government agencies and the GUIDe Consortium may forward this proposal to a government agency so that it might be considered for funding by that agency”. The author(s) and title of the

- original proposal will be cited when the proposal information is used in this manner.
- h) Personnel (include résumés of key personnel)
 - i) Commitment Letter (the commitment letter should be of the standard form that is used by the originating institution in submitting government proposals).
 - j) The proposal must be electronically delivered in pdf format and must be less than 10 pages in standard, single-spaced, business font and format. The pdf file must be less than 5MB.
- 4) Research Project Requirements & Guidelines
- a) Funding levels in the range of \$40,000 to \$100,000 per year are suggested.
 - b) Proposals can be for multiple years with a maximum of four years. It is anticipated that the program funding will be initiated on January 1, 2009. The funds for this GUIDe 4 program will be approved on a year-by-year basis subject to the availability of continuing funding and adequate research progress.
 - c) The Consortium will assign a Technical Subcommittee comprised of industry engineers to each research project. Researchers must be available for quarterly conference calls with Consortium subcommittees to discuss research findings and status. Within 2 weeks of this call the researcher shall prepare and deliver a short status report, including action items, to the subcommittee chair.
 - d) Researchers must attend and present research findings and status at an annual review. The presentation charts and an annual progress report must be delivered at this review. It is expected that these meetings will be held at Duke University. Travel funds should be budgeted for this purpose.
 - e) Publication of research results is not restricted. However, advanced copies of all technical papers on work supported in part, or in total, by the Consortium should be sent to the subcommittee chair for early distribution to Consortium members.
- 5) Proposal Submittal
- a) Deadline: proposal must be received by email by midnight on August 27, 2007
 - b) The proposal must be emailed to rkielb@duke.edu in pdf format. The size of the pdf file must be less than 5MB. Additional contact information is given below.

GUIDe Contact Information

Dr. Robert E. Kielb
GUIDe Consortium, Center for Aeromechanics
Duke University
Dept. of Mechanical Engineering & Materials Science
Box 90300
Durham, NC 27708-0300
Phone: 919-660-5327
Mobile: 919-426-3182
Email: rkielb@duke.edu

Appendix 1
Title Page Required Information

- 1) Project Title
- 2) Principal Investigator (PI) Name:
 - Employing Institution:
 - Mailing Address:
 - Phone Number:
 - Fax Number:
 - Email Address:
- 3) Co-Investigators
- 4) Total budget request for the project period and duration of the Project:
(MM/DD/YYYY to MM/DD/YYYY)
- 5) Certifying Representative of the PI's employing institution
 - Name:
 - Signature:
 - Employing Institution:
 - Mailing Address:
 - Phone Number:
 - Fax Number:
 - Email address:
- 6) Contractual contact of the PI's employing institution
 - Name:
 - Employing Institution:
 - Mailing Address:
 - Phone Number:
 - Fax Number:
 - Email address:
- 7) Date of Submission

Appendix 2

DRAFT
SOFTWARE LICENSE AGREEMENT BETWEEN
[UNIVERSITY]
And
[MEMBER]

This Software License Agreement ("Agreement") is entered into as of this ____ day of _____, 20__ ("Effective Date") by and between [UNIVERSITY], a not-for-profit corporation, having a principal place of business at _____ and [MEMBER], a _____ with offices at _____ ("MEMBER").

Recitals

- A. MEMBER is a member of the Guide 4 Consortium ("Consortium")
- B. Pursuant to MEMBER's Membership agreement for the Consortium, MEMBER is entitled to a non-exclusive, royalty-free, license to certain proprietary software developed by UNIVERSITY under the Consortium.
- C. UNIVERSITY hereby provides MEMBER with such license under the terms of this Agreement.

NOW, THEREFORE, in consideration of the mutual promises herein and intending to be legally bound, UNIVERSITY and MEMBER agree as follows:

- 1) UNIVERSITY owns or has the right to license certain computer software and related documentation (if any) listed in Appendix A hereto (collectively, the "Software").
- 2) In consideration of MEMBER's continued Membership and payment of fees associated therewith, UNIVERSITY hereby grants non-exclusive, non-transferable, perpetual (subject to termination as provided herein), royalty-free license to the source code of the Software to MEMBER.
 - a) MEMBER may modify the Software and/or make derivative works (collectively, the "Modifications").
 - b) MEMBER may use the Software and/or Modifications in support of engineering work directly related to design, developing, and selling its commercial products.
 - c) MEMBER may make copies of the Software for its use in accordance with this Agreement.
 - d) MEMBER may sub-license executable versions of the Software and Modifications for subcontractors to use, providing the subcontractors uses are directly related to design, developing, and selling MEMBER's commercial

- products. Only 5 active sub-licenses are permitted. Any breach of this Agreement by such a subcontractor will be considered a breach by MEMBER.
- e)
 - f) MEMBER may permit any subsidiaries in which it owns and/or controls at least fifty percent (50%) to use the Software and Modifications under the same terms provided to MEMBER in this Agreement, provided that any breach of this Agreement by such a subsidiary will be considered a breach by MEMBER.
 - g) MEMBER shall not use the Software and/or Modifications without written approval of the UNIVERSITY to:
 - i) Provide services to other companies
 - ii) Imbed the Software and/or Modifications in a commercial product
 - iii) Sell, give away, or donate the Software and/or Modifications
 - h) MEMBER shall not permit any third party to, decompile, reverse engineer, redistribute, repack, encumber, sell, rent, lease, sublicense, assign, time-share, publish, broadcast, circulate, market, donate, disseminate, retransmit, incorporate into a product which is then leased or sold or commercially-exploit the Software or any part thereof.
- 3) MEMBER acknowledges and agrees that except as provided below, the Software, Modifications and any and all associated intellectual property rights remain the property of UNIVERSITY and/or its applicable licensors and that MEMBER shall not acquire any ownership right, title, or interest therein. MEMBER shall retain any and all copyright designations in any and all copies of the Software and Modifications. However, notwithstanding anything to the contrary in this Agreement, UNIVERSITY agrees that MEMBER may own those certain portions of Modifications that do not incorporate any of the Software (in whole or in part) and may use those MEMBER-created portions without restriction.
- 4) In the event MEMBER breaches any material term of this Agreement and fails to remedy such failure within thirty (30) days after receiving written notice from UNIVERSITY, UNIVERSITY may terminate this Agreement effective upon written notice to MEMBER. Upon termination of this Agreement, MEMBER agrees to cease use of the Software and Modifications and to delete, destroy, or return all copies in its possession and/or control to UNIVERSITY, and to certify to UNIVERSITY in writing that it has taken such actions. Sections 3 through 14 (inclusive) shall survive the termination of this Agreement for any reason.
- 5) MEMBER agrees that the Software is proprietary and confidential information of UNIVERSITY and/or its applicable licensors and that it will not disclose the Software to any third parties without the prior written consent of UNIVERSITY. MEMBER shall exercise all reasonable precautions to prevent the disclosure of the Software by its employees or representatives, using a standard of care which is no less than that standard which MEMBER maintains to prevent the disclosure of its own confidential information, but in no event less than a reasonable standard of care. In the event MEMBER is required by law or court order to disclose the Software and/or any

Modifications, MEMBER shall provide reasonable advance written notice to UNIVERSITY to allow UNIVERSITY and/or the applicable licensor the opportunity to seek a protective order or other remedy to ensure the confidential handling of such information. MEMBER acknowledges that a breach of this Section could cause irreparable harm to UNIVERSITY and/or its applicable licensor which may not be able to be remedied by monetary damages. Therefore, in the event of a breach or suspected breach of this Section, UNIVERSITY and/or its applicable licensor may seek injunctive relief and/or specific performance in addition to any other remedies available to it in law or equity.

- 6) THE SOFTWARE AND ANY OTHER INFORMATION, MATERIALS, SERVICES, INTELLECTUAL PROPERTY OR OTHER PROPERTY OR RIGHTS GRANTED OR PROVIDED BY UNIVERSITY PURSUANT TO THIS AGREEMENT ARE ON AN "AS IS" BASIS. NEITHER UNIVERSITY NOR ITS APPLICABLE LICENSORS MAKE NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, AS TO ANY MATTER INCLUDING, BUT NOT LIMITED TO, WARRANTY OF FITNESS FOR PARTICULAR PURPOSE, MERCHANTABILITY, INFORMATIONAL CONTENT, NON-INFRINGEMENT, OR RESULTS OBTAINED FROM USE. IN NO EVENT SHALL UNIVERSITY OR ITS APPLICABLE LICENSORS BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS) ARISING OUT OF OR RELATED TO THIS AGREEMENT, REGARDLESS OF WHETHER UNIVERSITY OR ITS LICENSORS WERE AWARE OF THE POSSIBILITY OF SUCH DAMAGES.
- 7) MEMBER hereby agrees to defend, indemnify and hold harmless UNIVERSITY, its licensors, and their respective trustees, officers, faculty, staff, employees, students, attorneys and agents and their respective successors, heirs and assigns (collectively, "Indemnities") from and against any and all claims or demands made against any such Indemnitee and any related losses, expenses, fees, costs, damages, liabilities or obligations of any kind (including, without limitation, reasonable attorney's fees) arising out of or relating to MEMBER's use of the Software and/or Modifications, including but not limited to, any claims of product liability, personal injury, death, or damage to property.
- 8) UNIVERSITY and MEMBER are subject to and agree to comply with United States laws and regulations controlling the export of technical data, computer software, laboratory prototypes and other commodities (including the Arms Export Control Act, as amended and the Export Administration Act of 1979), and their obligations hereunder are contingent on compliance with applicable United States export laws and regulations. The transfer of certain technical data and commodities may require a license from the cognizant agency of the United States Government. UNIVERSITY and MEMBER agree to do all things necessary to comply with the Regulations of the United States Department of Commerce relating to the Export of Technical Data,

insofar as they relate to the Software, and to obtain any required government documents and approvals prior to the export of any technical data.

- 9) If the Software was developed under a United States Government funding agreement, then (a) the United States Government will be granted licensing rights as required under the terms of those federal agreements, and (b) any and all rights reserved to the United States Government and others under Public Law 96-517, and Public Law 98-620, including but not limited to government purpose license and march-in rights, shall remain and shall in no way be affected by this Agreement and any right granted in this Agreement greater than that permitted under Public Law 96-517, or Public Law 98-620, shall be subject to modification as may be required to conform to the provisions of those statutes.
- 10) This Agreement may not be assigned by MEMBER without the prior written consent of UNIVERSITY, except that MEMBER may assign this Agreement to any entity that acquires ownership of MEMBER, whether by merger, acquisition, consolidation or otherwise. Any attempted assignment in violation of this Section shall be null and void. Notwithstanding the foregoing, this Agreement is binding upon and shall inure to the benefit of the parties hereto, their representatives, successors and permitted assigns. No failure on the part of either party to enforce any covenant or agreement, and no waiver or successive waivers on its part of any condition of this Agreement, shall operate as a discharge of such covenant, Agreement, or condition, or render the same invalid, or impair the right of either party to enforce the same in the event of any subsequent breach or breaches by the other party.
- 11) If any portion of this Agreement shall be finally determined by any court or governmental agency of competent jurisdiction to violate applicable law or otherwise not to conform to requirements of law then the remainder of the Agreement shall not be affected thereby; provided, however, that if any provision hereof is invalid or unenforceable, then a suitable and equitable provision shall be substituted therefore in order to carry out, so far as may be valid and enforceable, the intent and purpose of the Agreement including the invalid or unenforceable provision.
- 12) Nothing in this Agreement, express or implied, is intended to or shall confer upon any person or entity other than UNIVERSITY or MEMBER any right, benefit or remedy of any nature whatsoever under or by reason of this Agreement, except that UNIVERSITY's third party licensor(s), if any, listed on Appendix A are intended third party beneficiaries of this Agreement.
- 13) This Agreement shall be governed by the laws of _____. Any dispute or claim arising out of or relating to the Agreement will be settled by arbitration in _____ in accordance with the rules of _____ and judgment upon award rendered by the arbitrator(s) may be entered in any court having jurisdiction. Notwithstanding the foregoing, UNIVERSITY may bring an action for injunctive

relief relating to breaches of confidentiality or the protection of its intellectual property rights.

- 14) This Agreement and the Membership Agreement constitute the entire Agreement with respect to the Software and supersedes all previous agreements and understandings relating to the subject matter of this Agreement. The Agreement may not be altered, amended, or modified except by a written instrument signed by the duly authorized representatives of both parties.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be duly executed in duplicate counterparts, each of which shall be deemed to constitute an original, effective as of the date first above written.

[MEMBER]

Name:

Title:

[UNIVERSITY]

Name:

Title: