

Focal Point

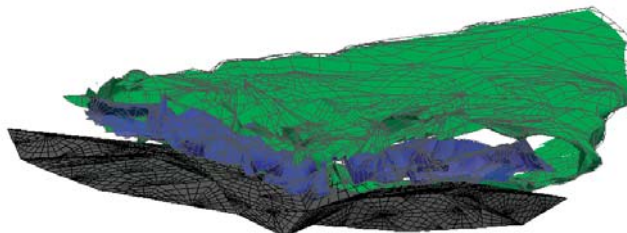
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THE NEWSLETTER FOR GRIDGEN USERS

Brown University Uses Gridgen to Simulate Bat Flight

People use computational fluid dynamics (CFD) for the battiest things, literally! Recently, researchers at Brown University used Gridgen to simulate and visualize airflow around a flying bat (the small nocturnal mammal, not the baseball hitting instrument). Their research is helping scientists better understand the aerodynamics of bat flight. The researchers hope to make discoveries in areas such as biomechanics, aerodynamics, and evolutionary biology.

One of the problems the Brown University researchers faced was determining the shape of the bat in flight. When bats fly, their wings undergo large amplitude motions and deformations. Plus, they move rapidly, making



Iso-surfaces around a bat in flight.

measurements difficult. The researchers devised a series of procedures to obtain the data needed to better understand bat flight.

In order to start, data were needed to create a geometric model. For this study, small-bodied (3-5 gram) bats from the species *Rhinolophus megaphyllus* were used. By flying more than 20 bats through wind tunnels, re-

searchers were able to obtain motion capture data of the bat's shape in flight. Two high-speed digital cameras tracked reflective markers under infrared illumination (nocturnal bats don't like bright light!) on the left side of the bat and software interpolated the camera data into 3D coordinates. The data was mirrored across the animal's

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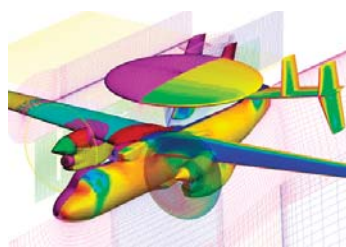


Focal Point is a publication of Pointwise, Inc. It is for Gridgen users and people interested in learning more about Gridgen and numerical grid generation. It includes information about the latest release of Gridgen, future development plans, and tips on how to get the most out of Gridgen while saving time in grid generation.

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Gridgen Product News: Version 15

By the time you read this, Gridgen Version 15 will be complete. This new, major release, scheduled to be shipped in June 2003, addresses three specific meshing challenges. For the management of large and complex databases and grids, a CAD-style layer manager and other tools have been added. In order to more closely couple Gridgen with your analysis software, support for volume conditions (i.e. material IDs) has been added as have new capabilities for boundary conditions. In the area of extruded meshes, a new re-ex-



E-2C image courtesy of Dr. Warren H. Davis, NorthropGrumman.

trusion feature has been added.

Managing Complex Models
A CAD-style layer manager has been added for database entities. The layer manager

can be invoked at any time while running Gridgen and appears in a new window. By assigning each database entity to a layer, you can easily control the visibility (and usability) of layers and the entities in them. For example, you can include all of the database entities for an aircraft's wing in one layer. Then when it is time to work on the wing mesh you can use the layer manager to make only that layer visible. The layer manager includes the ability to move entities from layer to layer,

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midline to get the right side shape.

The motion capture data was used to create a polygonal geometric model for each of 160 poses during a single wingbeat. Each bat wing was represented as a tessellation of triangles. An outer volume of approximately $10 \times 10 \times 20$ wing chord lengths was created around the bat, and Gridgen was then used to create a mesh in the volume around the bat for each pose. Using Gridgen's Glyph scripting language the Brown researchers were able to quickly create 160 different grids for different poses. About ten of the meshes are used to represent the flow through the entire cycle; meshes are replaced

as they deform too much. Together, they can be used to calculate a time-varying simulation of the flow through an entire wing beat.

The CFD code NEKTAR, developed at Brown University, was used to simulate the flow. For the present study, which serves as a proof-of-concept for a full, unsteady simulation, several static poses were modeled. The resulting flow was visualized in a 3D stereo virtual reality environment known as a CAVE.

Researchers noted several interesting flow features, including small vortices emanating from the trailing edge of the bat's wing.



Flying bat in upraised wing position with velocity vectors shown.

They successfully demonstrated their approach to bat flight modeling and laid the groundwork for future unsteady simulations. Look for new, more efficient bats to begin appearing in your backyard soon!

Article based on work by R. Weinsten, I. Pivkin, E. Hueso, S. Swartz, D. Laidlaw, G. Karniadakis, and K. Breuer, Brown University, Providence, RI.

Pointwise Leads Mesh Standards Team

Pointwise, Inc. has been awarded a research and development contract worth an estimated \$500,000 from the United States Air Force Research Laboratory (AFRL) for the development of an application programming interface (API) for unstructured meshing. Work on the 24 month research project, titled Geometry and Grid Modeling for Numerical Simulation (GGMNS), began in November 2002.

The goal of the GGMNS project is to develop an API to serve as a programming guideline for researchers developing new unstructured meshing techniques. AFRL and other agencies often fund such development with the hope that the new techniques will be incorporated into meshing applications for the benefit of the end user. However, without a

standard API, the software implementation of meshing research often requires considerable rework for integration into existing software. The rework is often sufficiently large that integration is never attempted or completed, and the end-user never benefits from the results of the research. A standard API would also benefit meshing researchers by allowing them to use existing meshing applications as frameworks for their research, rather than spending resources developing their own application frameworks.

Pointwise leads a broad industry team on the GGMNS project. The team includes subcontractors Boeing Phantom Works (St. Louis, Missouri) and Lockheed Martin Aeronautics Company (Fort Worth, Texas), and consultant Basis Software (Fort Worth, Texas). "We are very excited to be working for AFRL with this world-class team," said Dr. John P. Steinbrenner, Pointwise's Vice President of Research and

Development and principal researcher on the GGMNS project.

Frank Witzeman, Chief of the Computational Sciences Center of Excellence, AFRL, states "the GGMNS project has great potential for mutual benefit across many labs, the aerospace industry, and eventually the commercial sector. AFRL is a leader in fostering such innovative research, and the Pointwise team is providing us an excellent mix of expertise in software engineering, mesh generation and industrial application."

The GGMNS project web site is maintained at www.pointwise.com/ggmns/. GGMNS is an outgrowth of the efforts of the Unstructured Grid Consortium, an informal group of government, academic, and industry organizations committed to improving the interoperability and reuse of unstructured grid generation tools and technology.

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On Demand Manuals
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Gridgen Version 15 cont.

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name layers, turn on and off the display of individual layers, create layer sets for easy recall, save layer data to Gridgen's composite database file format, and read layer information from CAD files.

Pick masks can now be applied to database entity selection. For example, you can limit entity selection to only surface entities, or just circular arcs. No matter what is visible in the Display window, pick masks ensure you will only pick what you want to pick.

You can create groups of grid entities (connectors, domains, and blocks). For example, you can create a group consisting of all the connectors on the symmetry plane or all the domains on the database. Then, whenever those entities are needed you can simply pick the group by its name that appears at the top of the Browser.

Solver Interfaces

Volume conditions (VCs) can now be applied to the cells on a block's interior. VCs are just like your



solver's boundary conditions, but identify the type of cells within the block (for example, fluid-A, porous, solid). VCs are similar to material IDs in the structural mechanics field. If your selected Analysis Software supports VCs, the volume cells in your mesh can be sorted according to VC when they are exported.

Boundary conditions (BCs) are now permanent and will stay with a domain even after the block on which they are set is deleted. So if you create a block, assign boundary conditions, but then delete the block, the boundary conditions are not lost. When you recreate the block, its boundary conditions will be recovered from its domains.

Extrusion

You can now go back at any time and re-extrude, continue the extrusion of a grid that you've already

saved. The original extrusion attributes are remembered and all the capabilities are available including step forward, step backward, and attribute editing.

Quality based smoothing has also been added to prism extrusion. This optional smoothing, applied after each step to optimize orthogonality and/or aspect ratio, has been shown to increase the number of marching steps by a factor of two. Since each step size is usually larger than the previous one, the total extrusion distance can be increased by a factor of three to four.

Native CAD Readers

The Native CAD Readers in Version 15 have also been totally reworked for improved robustness of CAD file translation and faster import times. Version 15 has readers for STEP AP203 and AP214, Pro/ENGINEER Versions 18-2001, and CATIA Version 4.

For more information on V15, please go to our web site at www.pointwise.com.

Use Ctrl-Pick to instantly move the rotation point.

New Gridgen Version 15 Training Course

With the release of Version 15 in June, now is a good time to get Gridgen training on your schedule. If you have not attended training in a while, a refresher course may be a good idea. You can pick up all the new tools in Version 15 as well as those you have missed in recent releases.

In conjunction with the release of Version 15, the Gridgen training course is, of course, being updated to reflect the new version. However, additional restructuring of the training course is in the works. The new course structure is a task-based approach to learning the software. Additionally, fresh hands-on cases are being developed to tie in even more closely with the course lectures.

Visit the Support section of our web site, www.pointwise.com, to learn more about Gridgen training, see what course dates are scheduled for the remainder of the year, and to register for a class. Be sure to register early; demand is expected to be high with Version 15's release.

Gridgen Training 2003

Jul 15-17

Sep 16-18

Nov 4-6

Additionally there will be a one day on demand Version 15 training class scheduled independently of the regularly scheduled training classes. Please check www.pointwise.com/support/ to register or for more information.



IF YOU HAVE A GRIDGEN PROJECT AND WOULD LIKE TO SHARE YOUR SUCCESSSES, LET US KNOW. WE WELCOME STORY IDEAS AND ACCEPT ARTICLES. PLEASE SEND YOUR IDEAS TO HEATHER MCCOY AT FOCALPOINT@POINTWISE.COM



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New Gridgen Distributor



Please welcome CFD Beratung as the newest Gridgen distributor. Their territory is Germany, Austria, and Switzerland. They are replacing CFD Consultants as the distributor for these countries. CFD Beratung is the newly formed company of Dipl.-Ing. Uli Fuchs, who as many of you know, was the main Gridgen expert for CFD Consultants.

We are excited to have Uli and his new company as a distributor focusing on Gridgen sales and support. You can contact Uli at uf@cfd-beratung.de, +49 7472 282410, or CFD Beratung, Bodelschwingweg 4, 72108 Rottenburg, Germany.

Check out the scripting examples in the examples/glyph directory of your Gridgen installation.

Pointwise Consulting Services

Whether you are looking for help in generating a particularly difficult grid, need help during peak load periods, are just looking to get a quick start on a project, or want custom software development, Pointwise is ready to give you a hand. With over 30 years experience developing and supporting 3D grid generation software and applying it to demanding industrial applications, we have the expertise to get your job done right.

Call 1-888-GRIDGEN for more information.