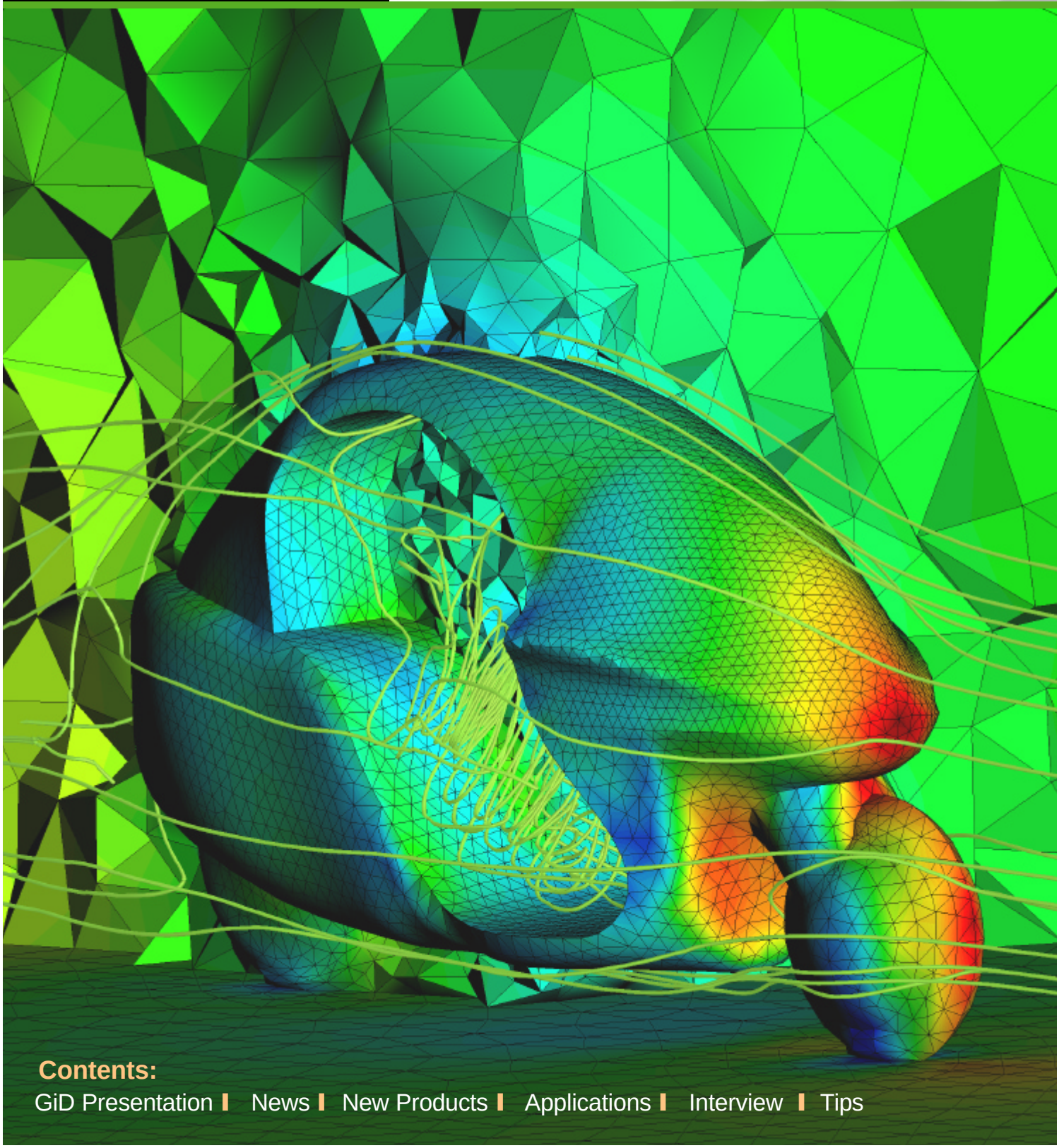
Vol.1, Spring 2001

GiD® Times

The Personal Pre/Postprocessor Magazine



Contents:

Presentation

Welcome

Preparation of analysis data and visualisation of results is one of the bottlenecks in the practical use of numerical methods. The problem is common to finite element, finite volume, finite difference, boundary element and meshless methods, among many other numerical techniques.

Access to faster computers together with the recent advances in research on numerical methods, has widened the scope of simulation of real life problems. As a result, is becoming quite usual the solution of problems on very complex geometries such as the structural analysis of a full car or an aeroplane, the study of the airflow within a sophisticated 3D domain or the modelling of the forming process of a mechanical part.

All these problems share some common aspects such as a complex geometry, the generation of a large mesh, the definition of the boundary conditions and other analysis data and the visualisation of results. GiD was conceived to make life easier to engineers in the solution of above problems by providing state-of-the-art pre and postprocessing facilities in a user-friendly, adaptive and personal environment. GiD also allows students to enter in the world of engineering analysis using PCs. Everyone can easily link their own numerical codes to the new pre and postprocessor. The portability of GiD in Windows, Linux and Unix systems is another key concept behind its broad use. Recent experiences have shown that all these features make GiD an universal pre and postprocessing tool for university students and also for engineers working in industry.

The new GiD Times magazine intends to present an entertaining overview of successful applications and recent developments of GiD. By extending the capabilities of GiD we wish to expand the scope of numerical methods for solving relevant problems for both industry and academia. This will invariably help to a better knowledge of the physical world as a necessary step to solve problems of interest to mankind.

Eugenio Oñate
Director of CIMNE

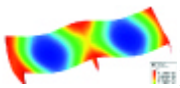
GiD+

GiD+ is a collection of computer simulation codes attached to GiD in the form of modules. It includes interfaces for third party software such as SAP-90/2000, NASTRAN, ANSYS and many others.

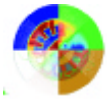
But GiD+ is more than just a collection of programs. It provides you with the possibility to create an easy-to-use complete software package to solve numerical problems, taking advantage of the distribution channels and marketing efforts of the GiD team and thus maintaining your autonomy as author of your code.

http://gid.cimne.upc.es/gidplus

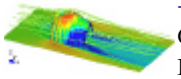
The current available GiD+ modules are:



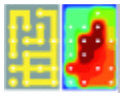
- **Calsef**: An analysis code based on the Finite Element Method for 2D and 3D solids, plates, 3D shells, axisymetric solids and shells. **www.cimne.upc.es/calsef**



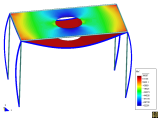
- **Emant**: A calculation tool that solves 2D magnetostatic problems using the Finite Element Method. **www.cimne.upc.es/emant**



- **Shyne:** This is a Computational Fluid Dynamics solver able to analise 3D viscous and inviscid incompressible flows. **www.cimne.upc.es/shyne**



- **Caltep**: This is a finite element program to solve the 2D Poisson equations, used e.g. in heat transfer and electromagnetic analysis. **www.cimne.upc.es/caltep**



- **RAM series**: A Finite Element Method simulation code for analysis of 3D beams, shells, coupled beams and shells and 3D solids. **gid.cimne.upc.es/ram-series**

GiD ANSYS interface

- **ANSYS:** allows the user to define the model and transfer the data to the comercial package ANSYS, where the analysis can be performed. **gid.cimne.upc.es/gidplus/main.htm#Ansys**

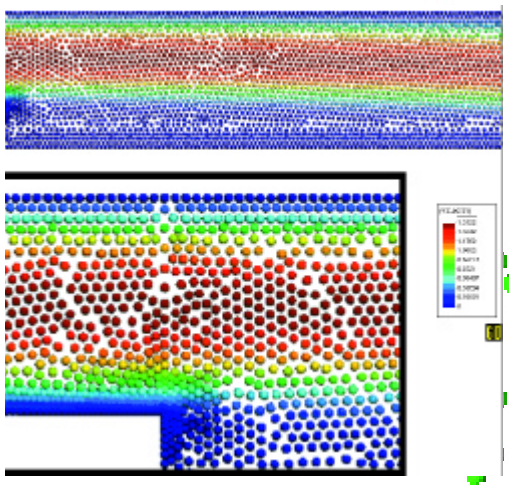
GiD NASTRAN interface

- **NASTRAN:** allows the user to define the model and transfer the data to the comercial package NASTRAN, where the analysis can be performed. **gid.cimne.upc.es/gidplus/main.html#Nastran**

Note: ANSYS and NASTRAN are registered trademarks. CIMNE is not a distributor for any of these simulation packages.

News

Meshless trends: the Finite Point Method



After recent work to improve fast and efficient meshing algorithms, a new numerical meshless method, the finite point method, shows promising features. Nevertheless this meshless method requires the definition of a set of well-distributed points to calculate anywhere the solution of the problem and even more, to visualise the results... and we are working on all these new requirements!

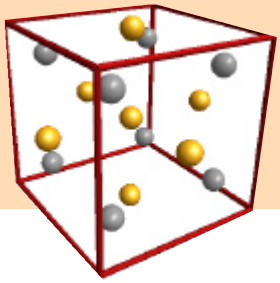
A finite point method for incompressible flow problems
E. Oñate, C. Sacco and S. Idelsohn
Computing and Visualization in Science 3, 67-75 2000.

A finite point method for elasticity problems
E. Oñate, F. Perazzo and J. Miquel
CIMNE publication no. 202 February 2001

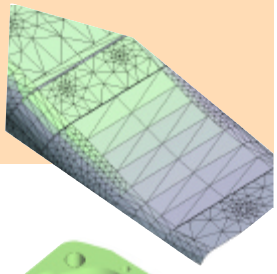
Tochnog

Tochnog is an explicit and impicit Finite Element Program with linear and nonlinear, elastic, hyperelastic, hypoelastic, plastic, visco, contact, thermal, and fluid capabilities with h/p refinements. Parallel or distributed solvers are available.
It does not provide shell elements but has 2D beams and trusses.

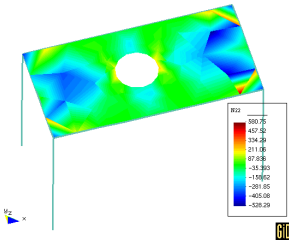
GNU General Public License **http://tochnog.sourceforge.net/**



meshing capabilities and result visualisation. A full documentation is provided at different levels.
A complete set of tutorials has also been added in order to optimise the learning curve.

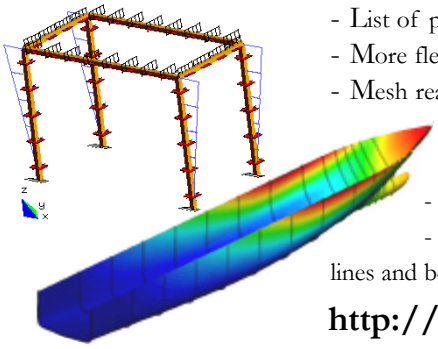


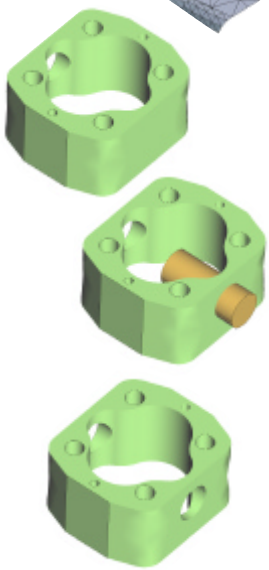
Key new features of GiD version 6 :



Enhanced geometry and render support: NURBS lines, surfaces, trimmed surfaces, collapse and uncollapse of model/surfaces, lines and surface offset's with volume extrusion.

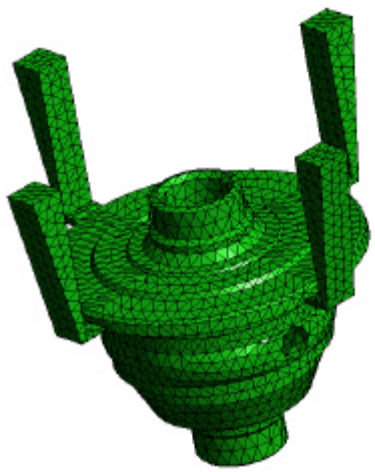
- Solid modeller (union, intersection and subtraction of volumes).
- Formats: IGES, VDA, DXF(14/2000), ParaSolid v11.0 (ascii/binary), AVI, gif, VRML, PNG.
- List of properties of entities (area, length, gravity centre).
- More flexible and powerful data input & visualisation.
- Mesh reading process enhanced, allowing mixing of elements.
  - New element types: points, lines.
  - Gauss point support for visualisation
- New result types (local axes, eigen vectors).
- New result visualisation options (scalar and vector diagrams over lines and beams, mesh or geometry conditions over results, etc.)



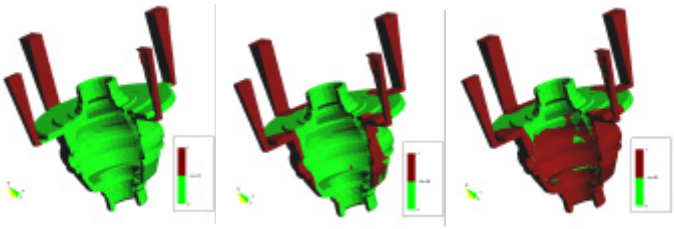


http://gid.cimne.upc.es

Computer simulation of casting processes



The mould filling process is of critical importance to obtain high quality parts by casting. Computer simulation improves the understanding of this process allowing the founder to improve the design of the filling system.Very complex CAD geometries with more than 1000 surfaces, used in this kind of analyses are imported into GiD and appropriate meshes containing over 100.000 linear tetrahedra elements are then generated automatically.

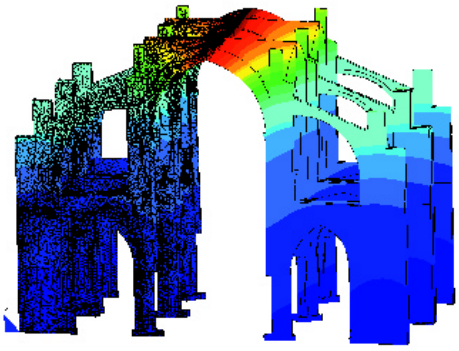


Numerical results for the evolution of the material front, pressure and velocity fields.
The animation of the results is of great help to understand transient aspects of the problem.

Some of the problems that may occur because of a bad filling process include trapping of air bubbles, porosity and oxidation associated with turbulence and sand particle pollution, among others, all of which can result in defective parts. The methodology used for this analysis includes a full viscous Navier-Stokes finite element code coupled to a free surface solver.

Contribution:
Xavier Royo, M.S. in Mechanical Engineering, Master in Numerical Methods in Engineering, currently working on metal casting and ship hydrodynamics at CIMNE

Structural analysis for damage evaluation in high value monuments

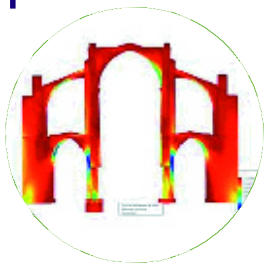


Non-destructive analysis is crucial in the evaluation and diagnosis of historical buildings. Accurate simulations can improve restoration and rehabilitation techniques, providing clear indications of the damaged areas.

In a damage model, a crack is considered as a local effect that increases with the applied load. This model can be used for the analysis of concrete and masonry structures to reproduce accurately the non-linear behaviour of the material under tension and compression stress.

A fine GiD mesh of more than 15.000 nodes and 67.000 tetrahedral elements has been used for the analysis of Tarazona Cathedral, built in 1162 in Zaragoza, in the north-est of Spain.

For this study the COMET program, a finite element multidisciplinary code developed at CIMNE, has been used. The symmetry in the real building allows to consider just one fourth of the vault of the cathedral in the final model.



Only the gravitational forces have been taken into account.

The problem was studied either with a linear and non-linear analysis with a damage constitutive model. The analysis reproduces the damage in the real structure. It also predicts the cracks and the compression crush at the base of the lateral vaults.

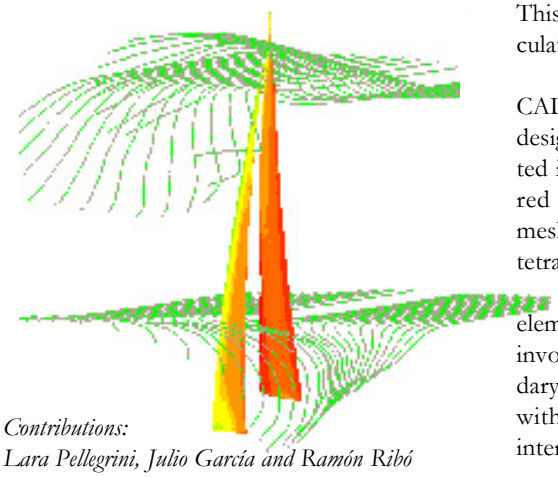
Contribution: Lara Pellegrini, M.S. in Civil Engineering and Master in Numerical Methods. she is currently a researcher at CIMNE, working on the coupling between mechanical and fluid-dynamic numerical techniques to solve multidisciplinary problems such as sail design.

GiD -The personal pre/postprocessor

Applications

Structural-aerodynamic design of sails

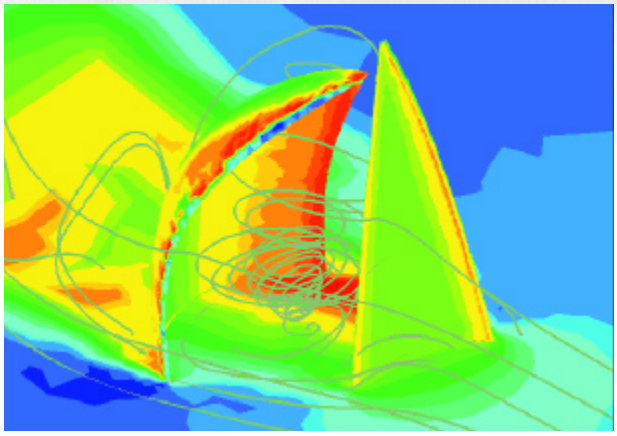
Q-SAIL is a finite element code to simulate the aerodynamic and structural behaviour of sails



Contributions:
Lara Pellegrini, Julio García and Ramón Ribó

The prediction of the flow around a sail and the basic analysis of its deformations because of the aerodynamic loads is a way of better understanding its behavior and performance, and a basic requirement to improve the industrials design.
The Q-SAIL software aims to be a virtual wind tunnel based on finite element method. This package is the result of the coupling of the code Shyne for the fluid dynamics calculations, Calsef for the structural analysis and GiD as the Pre and Postprocessor.

CAD data from Toni Tió design tools were imported into GiD and prepared for analysis using meshes of up to 500.000 tetrahedra elements and 5.000 surface elements. This problem involves complex boundary conditions to deal with fluid - structure interaction.

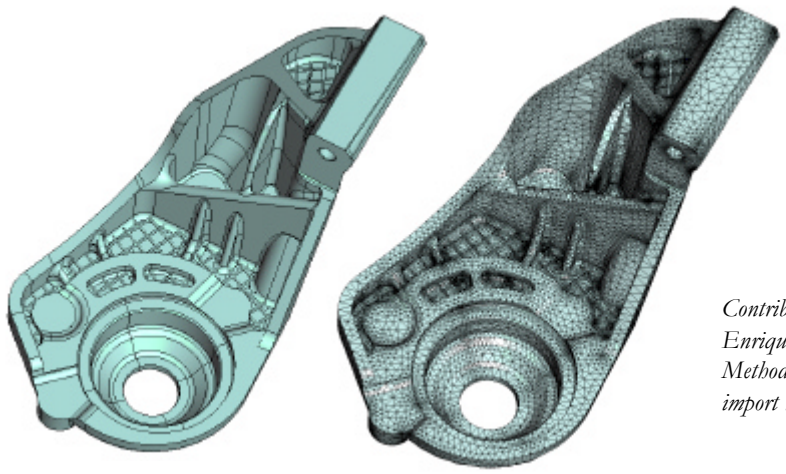


Excellent results have been obtained combining the fluid-structure interaction capabilities of the code and the industrial experience of 'Toni Tió Velas'.

Quantum Sails (Toni Tió Velas) is a sail manufacturer with a wide experience in design and production of sails for Team Champions in Spain, Europe, and the world in many classes, starting from Optimist, through 420, 470, going on to regatas like the Admirals Cup and classes like the Maxi (Withbread type). The loft is now world leader in One Design.

More information upon request to:
Quantum Sails (Toni Tió Velas) Manel Ventura i Campeny, 12, 08339 VILASSAR DE DALT (Barcelona)
Tel: +34 93 753 14 21 Fax: +34 93 753 39 00 e-mail: tonitio@intercom.es CIMNE: lara@cimne.upc.es

Advanced geometry import capabilities



GiD capabilities to import geometries from CAD and generate tetrahedra meshes are shown in this model example. The geometric shape is defined with about 1.000 surfaces and the mesh has about 300.000 tetrahedra elements.
GiD can read CAD data in DxF, IGES, VDA and NASTRAN formats.

Contribution:
Enrique Escolano, M.S. in Civil Engineering, Master in Numerical Methods in Engineering, currently working on preprocessing and import techniques at CIMNE.

Interview

Finite Element Mentors
A few words from O.C. Zienkiewicz and R.L. Taylor

Prof. O.C. Zienkiewicz

Prof. R.L. Taylor

visit:

http://www.swan.ac.uk/civeng/General/staff/ocz.htm

http://www.ce.berkeley.edu/~rlt

The book "The Finite Element Method (V Edition) by O.C. Zienkiewicz and R.L. Taylor is published by Butterworth-Heinemann 2000

GT (GiD Times): Two of the most eminent personalities in the finite element world have recently published the fifth version of their classic finite element book, which will portray the recent key advances in this important discipline. What are the main news of your book?

Z&T (Prof. Zienkiewicz & Prof. Taylor): This book is the 5th edition of the book originally introduced by Professor O.C. Zienkiewicz in 1967 and now co-authored with Professor R.L. Taylor. The book has grown continuously since that time reporting and presenting a state-of-the-art volume. The last (4th edition) appeared in 1989 and 1991 and the new volume includes the very important developments that have taken place since. These in particular refer to new processes of error estimation and adaptivity and of the treatment of convective-diffusion in fluid mechanics problems. Though the vehicle often is the linear elasticity or linear heat conduction problem, the procedures presented are quite general. In the second volume solid mechanics is chosen as the main topic and here the specialized problems of that area are discussed. In particular, problems on non-linear material behavior, large deformation and displacements, as well as, rigid body behavior are discussed. In addition all the matters of plates, shells and other thin-walled structures are here presented, summarizing the most recent developments. The third volume is entirely devoted to fluid dynamics and presents a novel universally applicable procedure, which is strongly recommended for all problems. Examples in that volume range from slow viscous flow, such as may occur in metal forming, to supersonic and hypersonic flow around aircraft and space vehicles. Further, ocean waves and estuary currents are also discussed.

GT: Your lives and finite element methods have evolved cheek to cheek so to speak, and one could well say that this discipline has reached the importance it has today thanks to your continuing research efforts. What progress can we expect to witness in the coming years?

Z&T: We hope that the picture given in the book together with several chapters devoted to future directions is clear and generally applicable. We believe that in the next few years 'meshless' methods may become more important than they are today and that many coupled problems with multiphysics background will become an every day occurrence. However, it is becoming clearer that the developments of the methodology and theoretical discretization are becoming fully documented and it is anticipated that the main thrust of research in the future may go into such directions as making the general application of numerical and computer simulation easier.

GT: Prof. Zienkiewicz holds the UNESCO Chair of Numerical Methods in Engineering at CIMNE , the birthplace of GiD. Could you tell the readers about this experience with CIMNE in general?

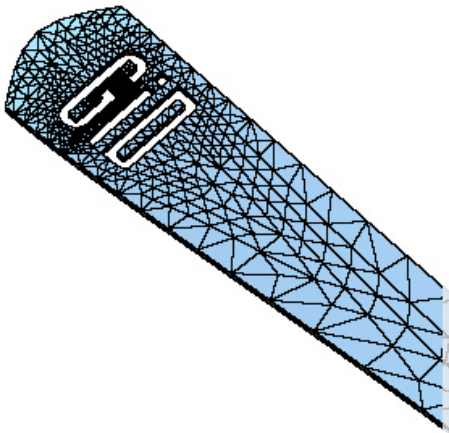
Z&T: Professor Zienkiewicz has been associated with the establishment of CIMNE since its birth, largely through a personal connection with Professor Eugenio Oñate who was a co-researcher at Swansea many years ago. Since the late 1980's he has been officially appointed as the first UNESCO Professor with the title of 'Numerical Method in Engineering' and spends annually several months collaborating with the workers and researchers of CIMNE. The vitality of research at CIMNE is known internationally and its atmosphere creates a very pleasant and stimulating background for our joint research. Indeed, the new book was largely written at CIMNE during our visits here and we hope that a Spanish edition will appear in the near future.

GT: You have long-standing experience with computer software for engineering applications. How do you see GiD positioned in today's competitive world of engineering design and visualisation tools? Professor Taylor himself distributes for free the source of a finite element simulation code over the Internet. In view of GiD's potential to link up with any kind of simulation codes, how and to what extend do you think could GiD add value to your simulation program?

Z&T: We have selected GiD to be the pre- and post-processor tool for the software we provide as part of the new edition of our book. The ability of GiD to generate a variety of mesh types automatically and the ease of interfacing it directly to our solution programs for solid mechanics and fluid dynamics applications were primary considerations in our choice. We believe this combination will create an analysis tool that allows educators and research scientists to explore and visualize solutions to problems for the many topics described above. Moreover, the power of GiD to create meshes for industrial type applications permits our readers to extend their capabilities to meet their present or future professional needs.

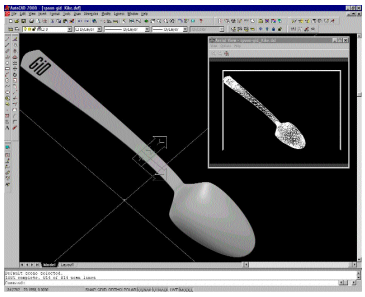
Tips

Exporting a GiD Mesh to Autocad DXF



GiD mesh of a spoon

One of the most powerful skills of GiD is the capability to create a personalised output file (see User Manual-Configuration and Compilation Files). In particular, a mesh created by GiD can be converted to the Autocad DXF format with the simple code presented in the following lines.



Autocat render of the spoon imported in DXF format from GiD

1) Create a new problem type called DXFout, i.e., create a subdirectory called `DXFout.gid` in the `problemtypes` GiD subdirectory.

2) Create the file called `DXFout.prb` with the next text:

```
PROBLEM DATA
END PROBLEM DATA
```

3) Create the file `DXFout.mat` to define different materials in the model. The materials will be treated as layers in the DXF format:

```
NUMBER: 1
MATERIAL: Generic
QUESTION: Property:
VALUE: NONE
END MATERIAL
```

4) Create the file `DXFout.bas` with the specific DXF format description:

```
*realformat "%15.5f"
*intformat "%7i"
*# Interface GID-DXF R12
*# Export triangle/quadrilateral
mesh
*# Created by Kike III - November
1999
*Set var HANDLE=21
0
SECTION
2
ENTITIES
0
POLYLINE
5
*format "%i"
*HANDLE
*Set var
HANDLE=operation(HANDLE(int)+1)
8
GiD
66
1
10
0.0
20
0.0
30
0.0
70
64
71
*npoin
72
*nelem
*loop nodes
0
VERTEX
5
*format "%i"
*HANDLE
*Set var
HANDLE=operation(HANDLE(int)+1)
8
GiD
10
*NodesCoord(1,real)
20
*NodesCoord(2,real)
30
*NodesCoord(3,real)
70
192
*end nodes
*Set elems(Triangle)
*Add elems(Quadrilateral)
*Loop elems
0
VERTEX
5
*format "%i"
*HANDLE
*Set var
HANDLE=operation(HANDLE(int)+1)
8
*#GiD
*format "%i"
M*elemsmat
10
0.0
20
0.0
30
0.0
70
128
*for(INODO=1;INODO<=nnode;INODO=INO
DO+1)
*format "%i"
7*INODO
*elemsConec(*INODO,int)
*end INODO
*end elems
0
SEQEND
5
*format "%i"
*HANDLE
*Set var
HANDLE=operation(HANDLE(int)+1)
8
GiD
0
ENDSEC
0
EOF
```

To export GiD meshes into a DXF format, you only have to follow these two steps: **1st:** In GiD, select DXFout in the problem type (Data -> Problem Type -> DXFout) and work with your model as usual. **2nd** : Write your DXF file (Files -> Import/Export -> Write Calculation File).

Enrique Escolano

More information: http://gid.cimne.upc.es/features/DXFout/DXF.html

Links:

- Internet Finite Element Resources: http://www.engr.usask.ca/~macphed/finite/fe_resources/fe_resources.html
- The INTERNATIONAL Association for the Engineering Analysis Community: http://www.nafems.org/

International Center for Numerical Methods in Engineering

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e.mail: cimne@cimne.upc.es
Web page: http://www.cimne.upc.es

GiD Times

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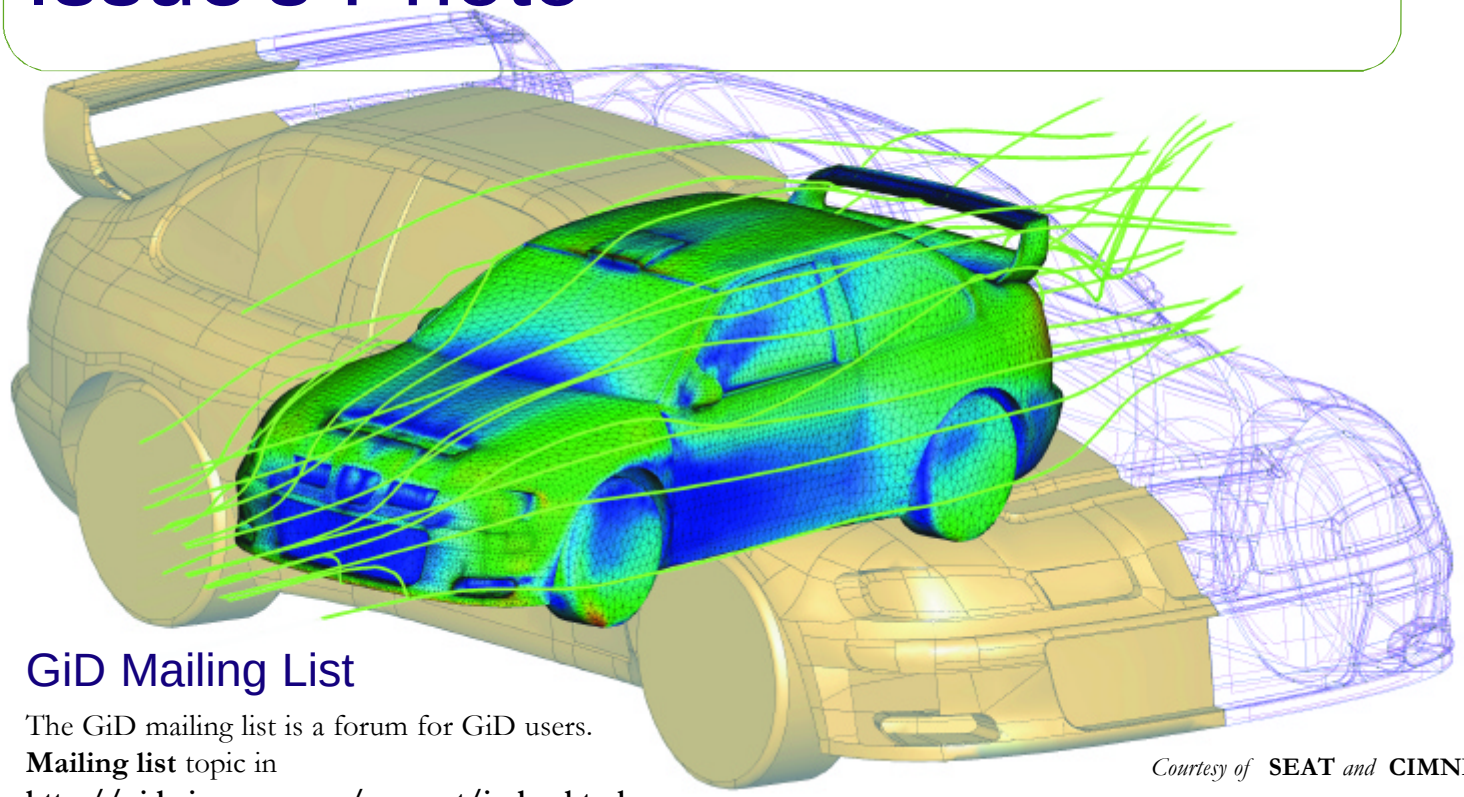
Issue's Photo



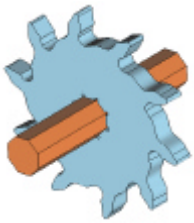
Courtesy of **SEAT** *and* **CIMNE**

GiD Mailing List

The GiD mailing list is a forum for GiD users.
Mailing list topic in
http://gid.cimne.upc.es/support/index.html

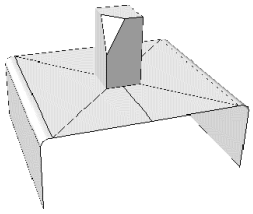
GiD Tutorials

Preprocess 1: *2D Tools, basic 3D Tools and Meshing*

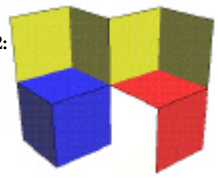


Preprocess 2: *Advanced 2D & 3D Techniques and Meshing*

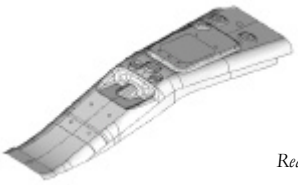
Meshing 1: *Assigning sizes to the elements of a mesh*



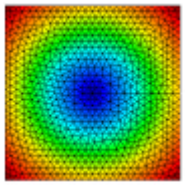
Meshing2: *Types of Mesh*



Postprocess: *Structural analysis using CALSEF and viewing results in GiD.*



Importing: *Reading IGES files*



Problem Type: *Configuring GiD for a particular type of analysis.*

All these tutorials are available in our Web Page: http://gid.cimne.upc.es/support/index.html