

## MAKINGITREAL



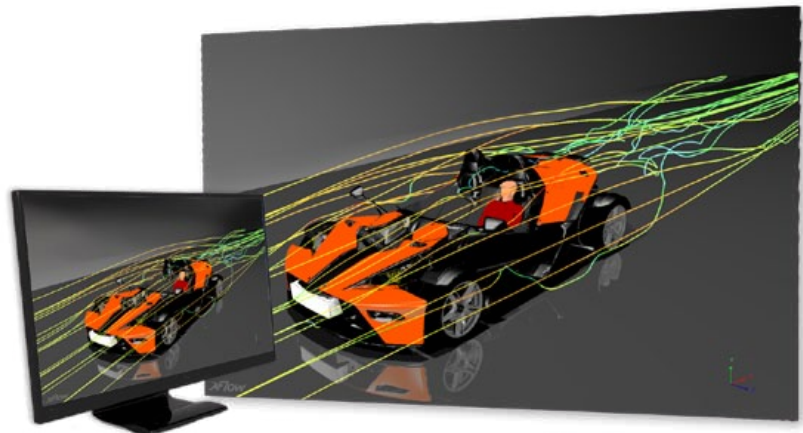
### XFLOW - FAST, MESHLESS CFD

Compumod is pleased to announce that in conjunction with MSC Software Corporation it is now marketing and supporting XFlow CFD solutions from Next Limit Technologies in Australia and New Zealand.

#### INSIDE THIS ISSUE



- 02 Welcome  
XFlow - Fast Meshless CFD
- 03 Adams 2012 New Release
- 04 Compumod Sponsors the...  
MSC Software recognised...
- 05 Lifemodeller
- 06 Compumod analysis assists Perth  
Mint cast record breaking Gold Coin
- 07 Marc 2011 New Release
- 08 New geometry and mesh clean up  
features in SimXpert 2012
- 09 ZW3D Christmas Specials
- 10 Actran : MSC Software  
International CAE Master's Degree
- 11 MSC Simulation Software in the  
High School Classroom
- Tips & Tricks!
- 12 Contact Improvements in  
Marc & Nastran
- Tips & Tricks!
- 14 ZW3D Morphing



XFlow is a powerful CFD technology that uses a proprietary particle-based, fully Lagrangian approach to handling traditionally complex CFD problems in engineering, design, science, and architecture with ease. XFlow provides the ability to simulate the flow of gases and liquids, heat and mass transfer, moving bodies, multiphase physics, acoustics and fluid structure interaction.

Developed for engineers and analysts who require quick feedback on complex flow behaviour, the XFlow approach to CFD analysis enables complex modelling in a straightforward and intuitive manner, minimising the presence of algorithmic parameters and avoiding the traditionally time consuming meshing process.

#### Key Features include:

**Meshless approach:** The meshless approach within XFlow is particle-based and fully Lagrangian which means classic fluid domain meshing is not required and surface complexity is not a limiting factor. XFlow can handle moving bodies and deformable parts, and is tolerant with the quality of the input geometry.



**Welcome** to Issue 4 of the 'Making it Real' Newsletter.

2011 has been a busy year for the team at Compumod as we have been re-establishing ourselves at the forefront of CAE in Australia and New Zealand and launching a number of new product lines and initiatives.

As I personally pass a milestone of more than 20 years in the Engineering Industry in Australia I find it somewhat disappointing that in general in this region we have still not embraced "high tech" simulation and engineering technology as well as other countries. In this time of low cost overseas manufacturing and cheap imports into Australia, I believe it is imperative that Australian and New Zealand engineers embrace high technology engineering solutions to enable us to design and manufacture high end products and services rather than simply trying to compete on price.

Compare this attitude with many European countries such as Germany, France, Holland etc where industry embraces high technology design and manufacturing and as such has been able to remain competitive on a global scale. This year I was also fortunate enough to spend some time in China where not only is manufacturing booming, but Chinese engineering companies are very busy skilling up their engineering resources through the use of the latest simulation tools that will enable them to create quality products that are not sold purely based on a low price point.

It is great when I visit our clients to see the amazing engineering design and simulation work being done in Australia, but it is disappointing that it is not more wide spread and not better understood by the industry as a whole.

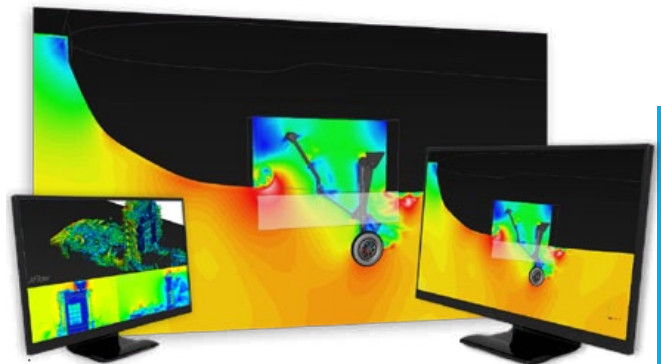
As part of Compumod's commitment to helping foster the awareness and use of high end engineering software tools we are proud to be sponsoring the inaugural "2012 Australasian Engineering Simulation Conference" to be held in Melbourne on Thursday March 29, 2012. This conference will act as a showcase for engineering companies to present and talk about their use of CAE technologies. It is Compumod's hope that this annual event will act as a focal point to help grow the awareness of CAE tools and capabilities as well as an excellent opportunity for Engineers to network with fellow CAE practitioners.

This newsletter also contains details on a raft of new software releases that will increase your productivity and enable you to solve hard problems faster than ever before.

Most importantly as we head into the holiday season I wish you and your families a safe and healthy break and all the best for 2012.

**Warwick Marx**  
Managing Director

## XFLOW [CONTINUED]



**Particle-based kinetic solver:** XFlow features a novel particle-based kinetic algorithm that resolves the Boltzman and the compressible Navier-Stokes equations. The solver features state-of-the-art LES (Large Eddy Simulation) modelling, and advanced non-equilibrium wall models.

**Advanced modelling capabilities:** XFlow is capable of handling large and complex models, and greatly simplifies the setup of analysis with moving parts, forced or constrained motion or contact modelling.

**Advanced analysis capabilities:** XFlow's solver also features thermal analysis, flow through porous media, non-Newtonian flows and complex boundary conditions including porous jump and fan models.

**Adaptive wake refinement:** XFlow's engine automatically adapts the resolved scales to the user's requirements, refining the quality of the solution near the walls and dynamically adapting to the wake while the flow develops.

**Single consistent wall model:** XFlow uses a unified non-equilibrium wall function to model the boundary layer. This wall model works in all cases, meaning that it is not necessary to select between different algorithms and take care of different limitations related to each scheme.

**Near-linear scalable performance:** XFlow is fully parallelized for multi-core technology with near-linear scalability.

■ XFLOW - FAST MESHLESS CFD SOLUTIONS

For more information on XFlow please call **1300 965 690** or email [info@compumod.com.au](mailto:info@compumod.com.au)







## NEW RELEASE – ADAMS 2012

Compumod are pleased to announce the new release of Adams 2012. This release of Adams delivers an all-new user interface and new model browser that simplifies model setup; new automatic flexible body generation to support efficient, high-fidelity system modelling; and an innovative tire model to complement the improved selection of standard events and road profile formats available for vehicle simulations.

### All-new User Interface

The Adams 2012 user interface provides a new ribbon-style format and intuitive layout. The new ribbon offers improved labels, thereby making model construction easier and more user-friendly. Engineers will find the main toolbox and build menu functions in a series of tabs for model entity construction, simulation, and post-processing actions, and icon strips are located on the main menu bar and status toolbar.

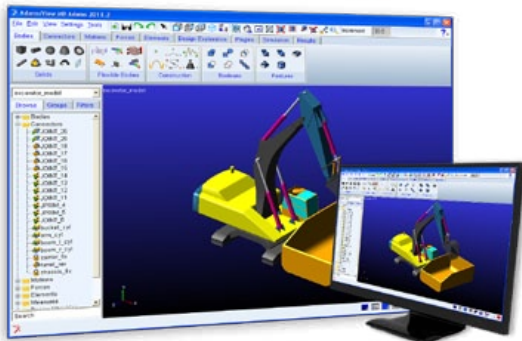


Figure 1 New Adams Interface with Ribbon menus & Model Browser

A new pre-processing model browser has also been implemented in Adams 2012, providing an improved means to navigate models within Adams/View. This is especially helpful in understanding the content of newly-inherited models from colleagues or business partners. Engineers will experience improved model navigation, especially for large models, convenient right-click access to non-graphical entities, dynamic search and savable filters, and improved visualization and model control.

### Automatic Flexible Body Generation

The Adams 2012 release introduces a new Adams/ViewFlex module that enables users to create flexible bodies without leaving the Adams environment and without the dependence on external finite element modelling (FEM) or analysis (FEA) software. The feature is powered by embedded MSC Nastran technology and run wholly in the background of the Adams session. This improves productivity and facilitates high-fidelity modelling.

### Enhanced Solver for Speed and Robustness

The improved C++ solver in Adams 2012 is now the default solver for all Adams products, including Adams/View and Adams/Car. The Adams C++ solver provides modelling and simulation capabilities not found in the FORTRAN solver, such as Nonlinear BEAM and FIELD formulations, flexible body contact, clearance measures, an exact linearization algorithm, a bisection method in the Adams/Controls system import option, support for delay differential equations, and parallel processing.



Figure 2 Adams ViewFlex for automated Flexible Body Generation

### Automotive Vertical Enhancements

Adams 2012 introduces new tire and road enhancements for Adams/Car where higher-fidelity road simulations can be performed. A new Tire 3D enveloping contact model is available to capture more realistic tire forces over small obstacles. Visualization of roads is now faster and more consistent with the simulation code, thereby enhancing a user's ability to understand vehicle behaviour and improve visual presentations.

New vehicle events have been added to Adams/Car including Straight-line Maintain, Straight-line Braking on Split  $\mu$ , and Static Vehicle Setup, which includes Mass Distribution for Corner Weights, Toe and Camber Alignment, and Ride height Adjustment. These new features provide users with a better selection of events, enhanced productivity and ease of use. In Adams/Chassis, the new flex body generation utility can now be used with any supported flex-body part, compared with only body and frame parts in the previously available body attachment finder utility. This improves productivity and facilitates higher-fidelity modelling.

For more information on Adams 2012 please call 1300 965 690 or email [info@compumod.com.au](mailto:info@compumod.com.au)



ADAMS 2012 NEW RELEASE



## COMPUMOD SPONSOR THE “2012 AUSTRALASIAN ENGINEERING SIMULATION CONFERENCE”

Compumod is proud to announce its sponsorship of the “2012 Australasian Engineering Simulation Conference”.



This conference will be held at the

**Melbourne Conference and Events Centre on Thursday, March 29 2012.**

The conference will consist of key note speakers from industry who will be detailing their Engineering problems and how they have addressed them using Simulation Software.

This is not a conference on theory but an opportunity to hear practising engineers talk about real work problems and their solutions to them.

This one day conference is a must attend for anyone in (or interested in) the Engineering Simulation Industry. Along with the presentation, the conference includes networking opportunities with fellow engineers via hosted morning and afternoon teas, lunch and post conference cocktail party.

Mark the date in your diary and look out for more details coming soon!

For further information please contact Compumod on 1300 965 690 or email [info@compumod.com.au](mailto:info@compumod.com.au)

## MSC SOFTWARE

### RECOGNISED AS ONE OF THE TEN ORIGINAL SOFTWARE COMPANIES

Did you know that in August this year MSC Software Corporation, was recognized by MaximumPC, as one of “The 10 Original Software Companies” along with other great software technology innovators like IBM, Computer Sciences Corporation, Apple, and Microsoft.

Debuting in 1963 as MacNeal-Schwendler Corporation, MSC specialized from the start in structural analysis, developing software for pre-PC computers that simulated the functionality of complex engineering designs. Its first product, SADSAM (Structural Analysis by Digital Simulation of Analog Methods), was designed specifically for the aerospace industry.

In 1965, MSC Software won the contract through a NASA-sponsored project to develop NASTRAN, which was estimated to have returned \$701 million in cost savings from 1971 to 1984. NASTRAN was inducted into the U.S. Space Foundation’s Space Technology Hall of Fame in 1988, as one of the first technologies to receive this prestigious honour.

Additionally, in a NASA Heritage of Creativity reference, it was stated that NASTRAN contributed \$10 billion+ value in “manned space flight contributions to humanity.” Since the company’s announcement of MSC Nastran in 1971; its proprietary version of NASTRAN, MSC Software has been dedicated to helping science, technology, and commercial manufacturing

industries like aerospace and automotive, excel in engineering and computer modelling and analysis. Today, the company continues progressive technology development efforts aimed at delivering certainty by expanding the horizon of engineering simulation, so companies can successfully simulate functional performance of increasingly complex engineering systems.

“It is both an honour and humbling experience for all of our employees that MSC was recognized as one of the top 10 original software companies in the world,” said Dominic Gallelo, President and CEO of MSC Software. “We are proud of our heritage as a software company that pioneered and contributed to the development of engineering simulation. The team at MSC is excited about continuing to drive the future of engineering simulation so our customers can deliver products that perform better, are more reliable, safer and greener.”

It is amazing to think that MSC Software Corporation will celebrate its 50th anniversary in February 2013.





## LIFEMODELLER

Compumod is pleased to announce that it has recently been signed as the sole representative in Australia and New Zealand of Lifemodeller, the leading global provider of biomechanical human body simulation tools and services.

Lifemodeller has a suite of state-of-the-art virtual human modelling and simulation software solutions built on top of the market leading MD Adams software from MSC Software. Its advanced capabilities and intuitive graphical interface, developed and refined over two decades, enable engineers, designers, and others interested in biomechanics to create human models of any order of fidelity, report true engineering data, and enable rapid and repetitive testing of designs, all while slashing time, cost, and risk from new product development.

Lifemodeller's software is used by more than 600 corporate clients and hundreds of universities and research institutions worldwide. Many of Lifemodeller's orthopaedic customers are realising productivity increases up to 20% and decreases in development costs by up to 40% while enhancing innovation and reducing risk.

"Lifemodeller is proud to be represented in Australia and New Zealand by Compumod. Compumod's reputation in the marketplace and technical expertise compliment the Lifemodeller product set perfectly" said CEO Shawn McGuan of Lifemodeller.

"We are excited to be representing Lifemodeller" stated Warwick Marx, Managing Director of Compumod who went on to say, "Lifemodeller's products meet a real need in the area of Biomedical simulation and should be of great interest to Australian companies and researchers who have shown to lead the world in this area"

Accurate, extensible, and built on the de facto standard for mechanical system simulation, Adams (MSC Software), Lifemodeller's software is readily integrated into corporate computer-aided engineering (CAE) workflows or university environments. LifeMOD can import complex product geometry from most popular computer-aided design (CAD) systems, including CATIA, Pro/E, SolidWorks, Unigraphics, ZW3D and others. It also easily imports engineering-formatted data from MRI and CT scans.

LifeMOD automatically produces standard plots of force, displacement, velocities, accelerations, torques, and angles. These powerful post-processing capabilities make creating clear, concise reports and attention-grabbing presentations complete with animations, plots, and charts, a simple task. Corporate management or other stakeholders can now truly grasp the 'what, why, how and when' of a given product's human interaction and subsequent evaluation.

Areas that Lifemodeller specialise in include:

### Orthopaedics/Medical



LifeMOD and Smith & Nephew: The JOURNEY Knee

### Sports/Equipment



LifeMOD : Optimising Performance

### Research/Education



LifeMOD : Accelerated Development

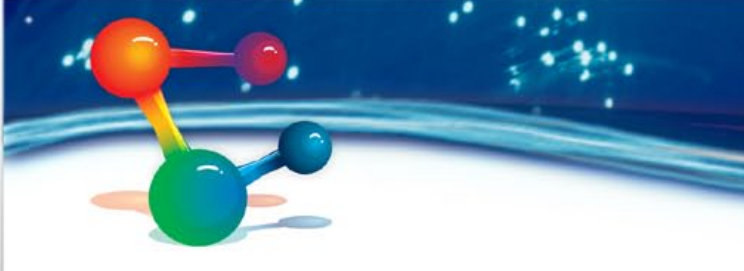
### Aerospace/Automotive



LifeMOD : Automotive Virtual Prototyping

To find out more about Lifemodeller's human simulation models call 1300 965 690 or email [info@compumod.com.au](mailto:info@compumod.com.au)





## COMPUMOD ANALYSIS ASSISTS PERTH MINT CAST RECORD BREAKING 1 TONNE GOLD COIN

Compumod is pleased to announce that its Finite Element computer simulation has been used to assist in the design and planning of the recently unveiled record breaking one tonne gold coin cast by The Perth Mint.

Weighing a massive one tonne of 99.99% pure gold, the monumental coin measures nearly 80cms wide and more than 12cms deep.

Prior to the casting Compumod was engaged by The Perth Mint to create a computer simulation of the planned pour in order to assess the mould and mould fixture's integrity to ensure they did not deflect to a point whereby the critical dimensions of the coin were affected.

Compumod undertook this work using MSC Marc software from MSC Software. This software enabled Compumod to undertake a Non-Linear Transient Finite Element Analysis (FEA) of the pour. Once completed, Compumod was then able to accurately predict temperature distributions and deflections of the mould and mould insert during the pouring of the 1,000 kg of 1,300 deg C molten gold into the mould.



Figure 1 Completed Coin Casting

Peter Brand, Technical Director of Compumod said, "At Compumod we have undertaken many interesting types of projects but this was definitely a one off! Due to the amount of gold being poured and its temperature, we had issues not just with the heat transfer and the variation in material properties of the mould and insert, but also the hydrostatic pressure of the gold itself in the mould. I am pleased to say that our analysis confirmed that the as designed mould and inserts were up to the task and we are proud to have been in a small way associated with this record breaking casting."

Phillip Kruger, Services Manager for The Perth Mint said "I engaged Compumod for this task as we had never before



Figure 3 Cast Coin

cast such a large coin and were concerned about the adverse effects of the forces and temperatures involved in 1 Tonne of molten gold. Compumod's results assisted to re-assure us that the design we had commissioned for the mould and inserts was up to the task and would produce the high quality gold coin we have today."



Exclusive behind-the-scenes footage of the creation of the coin can be seen at [1tonnegoldcoin.com](http://1tonnegoldcoin.com) or [youtube.com/user/perthmintbullion](http://youtube.com/user/perthmintbullion)



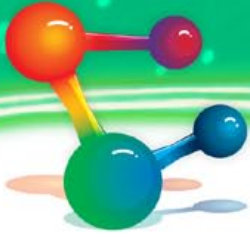
Figure 4 Cast Pouring

For more information on any Compumod Products or Services please call 1300 965 690 or email [info@compumod.com.au](mailto:info@compumod.com.au) or visit [www.compumod.com.au](http://www.compumod.com.au)



COMPUMOD ANALYSIS ASSISTS PERTH MINT





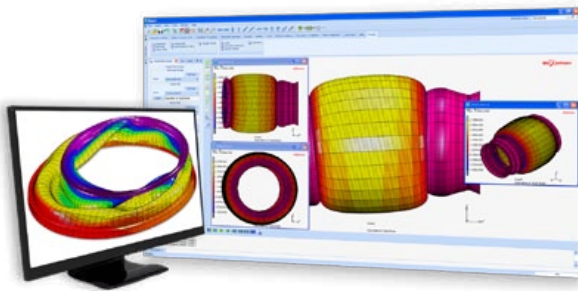
## NEW RELEASE – MARC 2011

Marc is MSC Software's powerful, general-purpose, nonlinear finite element analysis solution which can be used to accurately simulate the response of your products under static, dynamic and multi-physics loading scenarios. Marc enables you to simulate complex real world behaviour of mechanical systems making it best suited to address your manufacturing and design problems in a single environment.

The new 2011 release of Marc is easier, smarter, and faster; enabling engineers new to nonlinear analysis to achieve faster productivity, while providing a host of new features that longtime Marc users are extremely excited about.

### Easier User Interface and Model Setup

Marc's all-new user interface (Mentat) combined with improved CAD interoperability and meshing features makes it easier for engineers to create Finite Element Analysis (FEA) models and quickly learn the software program.



**Figure 1** Types of Highly non-linear Analysis in which Marcs excels plus the New Marc GUI

The new product is designed to provide users with an intuitive interface that improves users experience through:

- ▶ Easier model navigation
- ▶ Easy to use menu organization
- ▶ Native CAD import and faster, improved meshing
- ▶ Easy Customisation

Instant benefits are delivered to both new and current users including increased productivity, shorter learning curves and faster FEA model setup. Customers new to nonlinear FEA will be delighted with how easy it is to set up contact problems in Marc compared to other nonlinear products.

### Smarter Contact Setup and Analysis

The All New Marc enables smarter setup of nonlinear contact problems including expanded segment-to-segment contact for large deformation analysis, along with other contact enhancements. The segment-to-segment method provides smoother contact stresses and has been enhanced to support directional friction, improving accuracy for engineers.

For multi-physics analyses like heat transfer and electrostatics, the 2011 release enables engineers to utilise a "perfect" glue approach for thermal or other type of contact between bodies. In coupled multi-physics analyses, the "perfect" glue condition can be selected on a pass-by-pass basis. For example, in a coupled thermal/mechanical analysis, it may be desirable to have touching conditions in the mechanical pass (so relative sliding is still possible), but glued conditions in the thermal pass simulating perfect heat conduction in the contact area.

### Smarter Fracture Mechanics and Composites Analysis

The Marc 2011 release has several improvements for fracture mechanics and crack propagation including enhanced Virtual Crack Closure Technique (VCCT) and newly implemented Lorenzi method. Crack propagation has been improved both with respect to the physics of the crack motion, and also with respect to flexibility of usage.

In addition to the previous crack propagation methods based on remeshing, constraint release and splitting along element edges, this release offers a new method based on a cut through the element and is available for shells, 2D and axisymmetric elements. In addition, crack bifurcation capability is also implemented which enables engineers to analyze the effects of reinforcing members such as struts and spars on crack growth.

From a composites analysis standpoint, the 2011 release allows engineers to achieve a more accurate prediction of failure through a new Strain Invariant Failure Technique (SIFT), which is based upon the introduction of an amplified strain and examination of the invariants of these amplified strains. Composites simulations result in a massive amount of data, especially when there are a large number of plies in the material. To facilitate the evaluation of the results, new post codes have been added which will result in the maximum and/or minimum quantities through the thickness to be placed on the post file.

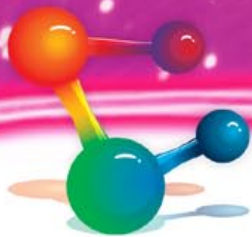
Several new electromagnetic tetrahedral and triangular elements are also available in this release for performing both harmonic and transient electromagnetic simulations. These elements may also be used in induction heating simulations. This makes it easier to work with complex geometry and meshes.

### Faster Nonlinear Simulations

Marc 2011 offers enhanced solvers for parallel processing that enable faster simulations and significant improvements in computational performance. Out-of-core implementation of the Pardiso solver has been shown to perform nearly as well as the in-core solver. This would help engineers run larger models and take advantage of high performance processing at no additional cost.

For more information on Marc 2011 please call 1300 965 690 or email [info@compumod.com.au](mailto:info@compumod.com.au)



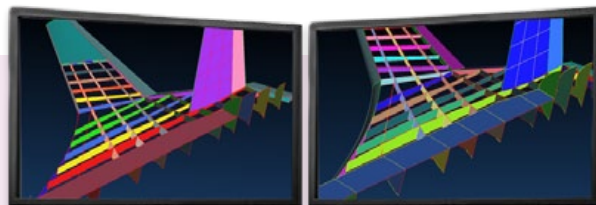


## NEW GEOMETRY AND MESH CLEAN UP FEATURES IN SIMXPRT 2012

SimXpert 2012 will be released soon and it contains a lot of nice new features. Some of these features are especially useful in cleaning up imported or created geometry. In this article I will show a few examples via the images below.

### Geometry:

- ▶ Stitching improvements (see Figure 1);
- ▶ Midsurface enhancements;
- ▶ Defeaturing enhancements (see Figure 2-4).



**Figure 1** Automatic geometry stitching to make incongruent geometry (on left) congruent with one button click

### Meshing:

- ▶ Feature based meshing;
- ▶ Constraints, mpc's and mesh update with geometry/mesh modifications;
- ▶ Interactive surface meshing enhancements (see Figure 5).

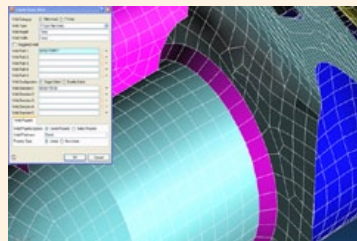
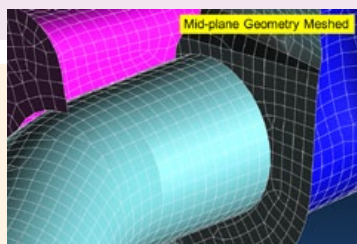
### New geometry and mesh clean up features in SimXpert 2012



Lengthen / Shorten / Expand / Shrink / Thicken / Widen

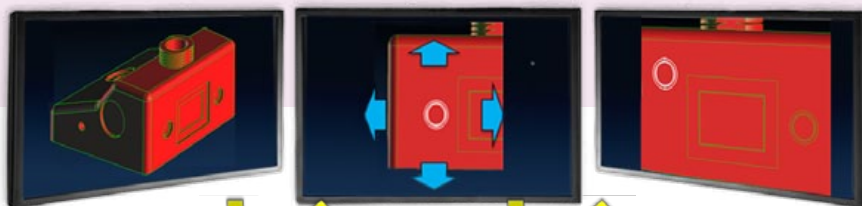
Move or Re-locate

**Figure 2** Examples of manual moving or changing of features



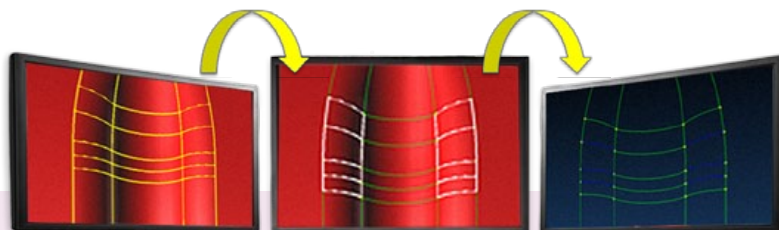
**Figure 5** Example of mesh assembly tool to add a T-joint fillet and connect / update two non-congruent meshes automatically

Merging Surfaces



Short Edge Collapse or Merge Vertices

**Figure 3** Examples of merging surface edges



**Figure 4** Example of merging faces or surfaces



# ZW3D

**SAVE  
UP TO 15%  
OFF THE \$2500 RRP**



## CHRISTMAS SPECIAL

Until 31st December 2011 Compumod has an end of year special on ZW3D Standard version, save up to 15% off the \$2,500 RRP.

With the official launch of ZW3D 2012 scheduled for March 2012, all purchases of ZW3D 2011, from the middle of January 2012 until the official release will receive a free upgrade to ZW3D 2012.



Figure shows the Ribbon Menu [above] introduced in the release for the ZW3D 2012 version

### All-in-one, affordable 3D Design.

ZWSOFT is famous for its affordable 3D Design software, which delivers better design and cuts time to market - ZW3D gives you even more power for your money.

### Data Exchange

Read and work with CATIA V4 / V5, NX, Pro/E, SolidWorks, Inventor, Parasolids, STE, IGES, STL, DWG, etc. to promote collaboration throughout the supply chain.

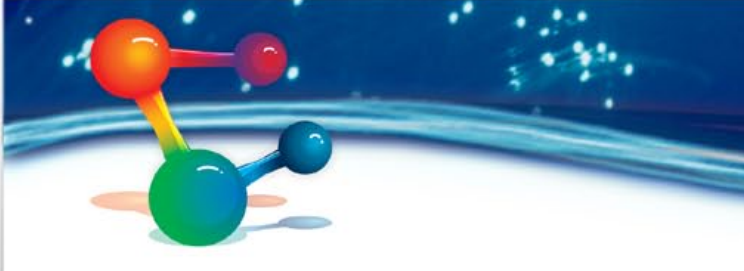
### Assembly

Lightweight ZW3D Burst™ technology enables very large assemblies to be manipulated at high speed without computer memory constraints. These can then be stored in the most appropriate way for each project. The tree structure for an assembly allows individual components to be graphically highlighted for easy modification. The PartSolutions™ library makes standard parts from leading suppliers instantly available to the designer. Data management, controls design revisions and engineering changes.

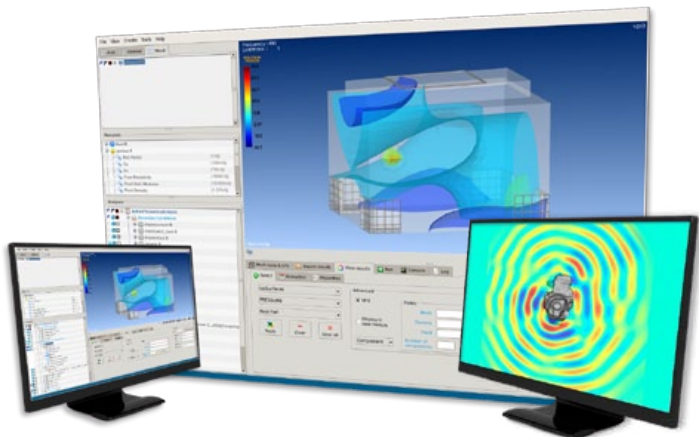
**ZWSOFT** Design More. Pay Less.

For more information on ZW3D products call 1300 963 690 or visit [www.compumod.com.au/Partners\\_ZWSoft.php](http://www.compumod.com.au/Partners_ZWSoft.php)





## ACTRAN - MSC SOFTWARE ACQUIRES ACOUSTIC LEADER FREE FIELD TECHNOLOGIES



In September this year MSC Software Corporation announced the acquisition of Free Field Technologies (FFT) the creators of Actran acoustic simulation software.

Recognized as the leader in the acoustics and NVH simulation software markets, FFT is a global software company providing solutions which address acoustics and NVH engineering challenges in automotive, aerospace, consumer products and a broad range of other industries. Bringing FFT together with

MSC's existing NVH solutions family in MSC Nastran, positions MSC as a powerhouse to deliver robust acoustics and NVH solutions to customers worldwide.

FFT's Actran is a single software product with features for modelling acoustic phenomena, including specialized options and modules for particular applications and industries, such as aero-acoustics, vibro-acoustics, and automotive NVH. Actran modules interface with most FEA structural analysis codes including MSC Nastran, ABAQUS™ and ANSYS™.

"Passenger comfort and increasing noise regulations are driving a rapid increase in the need for acoustic simulation technology in the automotive and aerospace and other industries. Further, perfecting customer-pleasing sound is simply a must in consumer products," said Dominic Gallelo, President & CEO of MSC Software. "FFT is the best in the world at satisfying both of these needs and we are excited to bring these technologies to the MSC global user base and beyond. We are delighted to have such a talented team join MSC."

For more information on Actran please call **1300 965 690** or email [info@compumod.com.au](mailto:info@compumod.com.au)



## INTERNATIONAL CAE MASTER'S DEGREE

Did you know you can now study online for a Master's Degree in *The theoretical & practical application of finite element method and CAE simulation?*

This Master's Degree, presented jointly by the *Spanish Open University ETSII/UNED* and *Ingeciber* in Spain has its genesis back in 1993 when the two organisations unified their wide experience using numerical analysis methods in different research areas and professional engineering applications.

The objective was, and still is, to prepare specialists in the use of Finite Element Method (FEM) and CAE Simulation for practical professional application.

This course which is approximately 40% Theory and 60% Application and Practices will be available in English for the first time in 2012.

Students who complete the course will be eligible for a Postgraduate Degree from the UNED, which is the largest University in Spain with more than 200,000 students.

To date more than 2,500 postgraduates have participated in this Master course, which clearly demonstrates that the course has obtained wide prestige and recognition over the years.

The multi-dimensional curriculum is aimed not just at acquiring knowledge but also at developing critical thinking and analytical ability and facilitating research at every stage of the course.

The course offers three different degree options (Expert, Specialist and Master's) to pursue your training through core and elective subjects.

If you are interested contact Compumod on [info@compumod.com.au](mailto:info@compumod.com.au) and we would be happy to send through further details.







## MSC SIMULATION SOFTWARE IN THE HIGH SCHOOL CLASSROOM

WRITTEN BY  
JOSHUA MARX

For my year 9 major science project I decided to do a computer simulation on a skateboard deck to see how different materials would make a difference to how the skateboard performs. The materials that I tested were Steel, Plywood, Aluminium, Plastic and Carbon Fibre. The idea was to do bending, torsional and normal modes simulations on the different material properties to see how they vary.

The following details the process I used to undertake this investigation:

Using ZW3D, a 3D solid model of the skateboard deck was created as per Figure 1.

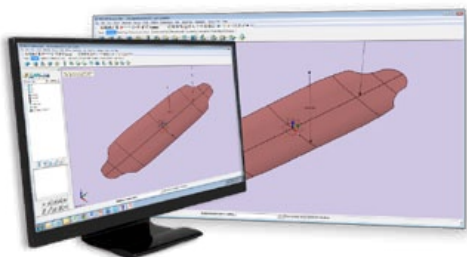


Figure 1 ZW3D Solid Model

I then imported a parasolid file from ZW3D into MSC Patran where I meshed the board, applied boundary conditions and loading. I simulated the board in a pure bending load case, pure torsion and then also did a normal modes analysis. This is because flexibility and vibration sensitivity are important in high speed skateboard deck design.

I also undertook a physical experiment of a plywood deck to check to see if the simulation was going to give accurate results. I did this by spanning a skateboard deck between two sets of bricks and standing on it and then measuring the deflection at the centre. I then applied the same amount of mass from the experiment into the simulation.



As per the image below, I then did a simulation of this experiment and found that the simulation the results were very close to the test results (within 0.3mm or around 4%).

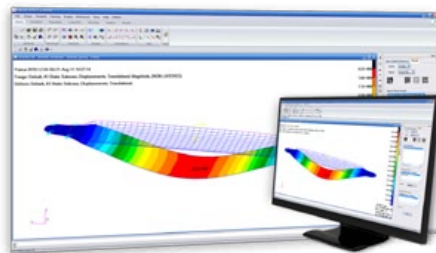


Figure 3 Pure Bending Simulation of Physical Test

As this showed the model was accurate I then proceeded to vary the material properties and do bending, torsional and normal modes simulations for all variations.

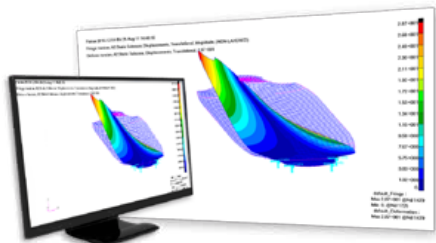


Figure 4 Torsional Simulation Results

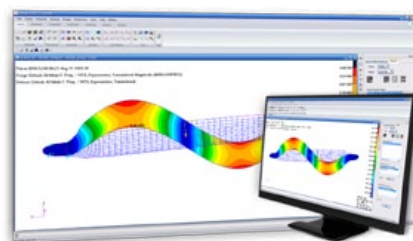


Figure 5 Normal Modes Simulation Results - Mode 3

Figure 2 Experimental Setup for Bending Tests

The results of the bending and torsion Stiffness are shown in Table 1 and the Frequency of the first 3 modes in Table 2.

Material	Deflection (mm)	Torsional Stiffness (mm)
Low Carbon Steel	0.54	1.79
Plywood	8.20	28.70
Aluminium	1.33	4.50
Plastic	9.55	36.20
Carbon Fibre	0.60	3.02

Table 1 Bending and Torsional Stiffness results

Material	Mode 1 (Hz)	Mode 2 (Hz)	Mode 3 (Hz)
Low Carbon Steel	77.05	139.37	225.60
Plywood	50.74	89.446	148.15
Aluminium	83.62	149.41	244.52
Plastic	53.35	90.93	155.10
Carbon Fibre	171.99	258.3	490.26

Table 2 Normal modes frequency for first 3 modes

I found that plastic was not a suitable material at all, steel would be good if it wasn't so heavy, aluminium would have almost the same performance as wood, and that carbon fibre was the lightest, and strongest. I also found that computer simulations can be a really good way to gain an insight into the performance of a skateboard without having to build actual prototypes and do actual testing.



## TIPS AND TRICKS!

### CONTACT IMPROVEMENTS IN MARC AND NASTRAN

Over the last 4 years MSC Marc and MD Nastran have shared the same components for 3D contact. With the recent merge of MD Nastran and MSC Nastran, all those advanced contact capabilities have also found their way into MSC Nastran 2012.

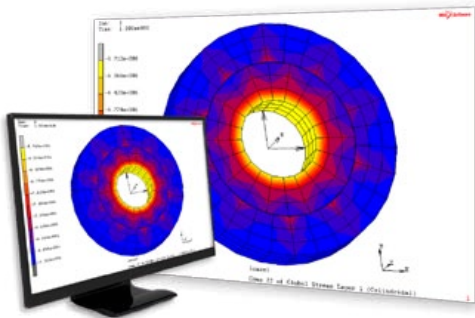
In this article we will show you some of the improvements in the 3D contact from the latest versions that you can access either with MSC Marc or MSC Nastran (SOL 400 and SOL 600 for a true nonlinear solution, SOL 101 for contact in a linear static solution or as glued contact for the other solutions).

### SEGMENT TO SEGMENT CONTACT

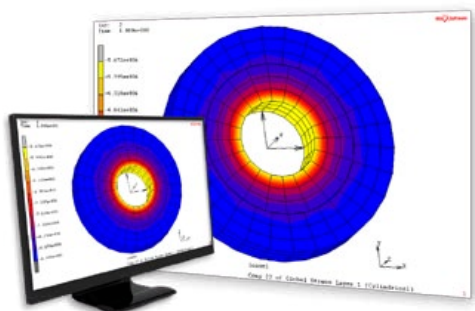
Segment to segment contact is a new alternative to the traditional master-slave contact. The contact definition is the same as always: body to body where each body consists of a set of elements. Internally the program then finds the nodes and faces (segments) on the outside of the body for contact detection. Traditionally one body was defined as the slave body and the other body as the master body. The slave nodes contacted the master segments. With the new segment to segment contact, there are several advantages compared to the master-slave approach:

In segment to segment contact:

- ▶ The order of the bodies is now irrelevant. You don't have to worry about mesh density or relative stiffness between the two contact bodies anymore;
- ▶ The contact stress contours are smooth and continuous as seen in Figure 1;
- ▶ It works very well with self contact of collapsing rubber seals due to its ability to handle ill conditioned systems and to have contact between three or more segments on one location;
- ▶ You won't have any more conflicts with spc or mpc relations as the segment-to-segment contact is based on a penalty approach;
- ▶ You can now define true double sided contact for shells (the shell has segments on each side) as shown in Figure 2;
- ▶ All the limitations for segment to segment contact that were present in the previous version have now been removed.



**Figure 1** Interference fit contact: master-slave contact (top) and new segment to segment contact (bottom). The contact stresses are much smoother for the segment-to-segment approach



### LINEAR CONTACT MODELING

#### 1. Linear contact definition

In an FE model, elements not connected via a common node are not aware of each other and would pass right through each other in a standard finite element analysis. Thus, standard finite element solutions are not sufficient for contact problems. In this newsletter, linear contact, one of the contact algorithms used in MD Nastran (and MSC Nastran 2012) is introduced. Linear contact is defined as the full nonlinear contact algorithm of SOL 400 without material nonlinear requirements or the usual linear requirements of small strain and small rotation imposed.

MD Nastran (and now MSC Nastran 2012) SOL 101 supports linear contact analysis provided that contact is the only nonlinearity in the analysis.

It has the following features:

- ▶ The contact bodies need not be in initial contact, and multiple contact bodies are allowed
- ▶ The grids of the contacting bodies need not be aligned, and the contact algorithm may be used to join dissimilar meshes with relative motion
- ▶ Both deformable-deformable and deformable-rigid contact is allowed
- ▶ Only surface to surface 3D contact is currently supported
- ▶ Bilinear Coulomb or bilinear shear friction is allowed

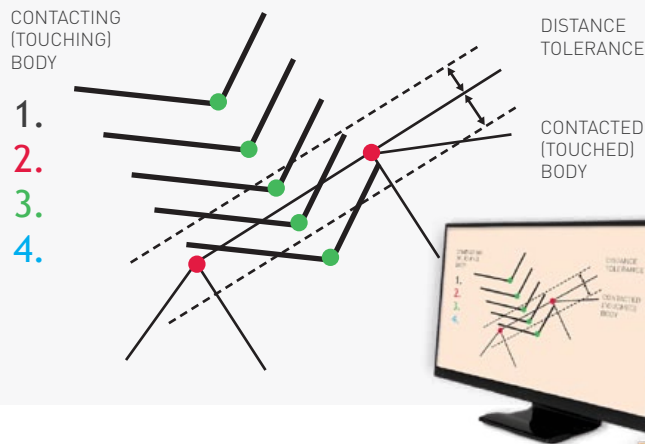




## TIPS AND TRICKS! [CONTINUED]

### 2. Contact detection in a static analysis

Four possible contact situations are shown as below



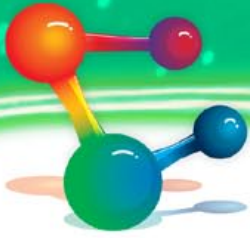
- 1 Node outside element, outside distance tolerance. Bodies are not in contact.
- 2 Node outside element, inside distance tolerance. Contacting node is projected onto segment of contacted body and remains in contact if necessary force is less than separation force.
- 3 Node inside element, inside distance tolerance. Contacting node is pushed back onto segment of contacted body.
- 4 Node inside element, outside distance tolerance. It means node penetrated and increment will be recycled with modified time step. If this situation occurs at beginning of analysis, contact will not be found.

### 3. Linear contact setup

### 4. Summary

After running a model in SOL 101 the user determines that there are other nonlinear effects such as material nonlinearity or large rotation, the model can simply be switched to SOL 400 without having to redefine the contact surfaces.

TIPS AND TRICKS! MARC & NASTRAN



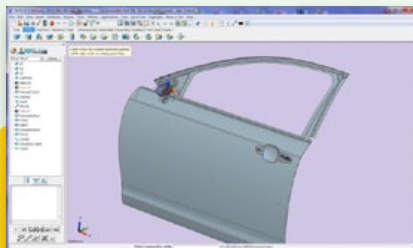
## TIPS AND TRICKS!

### ZW3D MORPHING

The Morph command transforms a shape by warping face geometry. Modifications are not limited to a single face, but works across edges whilst maintaining the integrity of the solid shape.

In this example we will use the **Morph Shape Curve to Curve** - this command allows you to grab a curve on a model and morph it to a destination curve. The surfaces near the curve are modified.

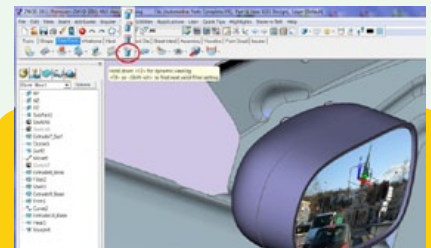
Our example geometry is an Automotive front door. The rear view mirror main body has been modelled and placed in the required location, but it requires blending between the body and the door skin.



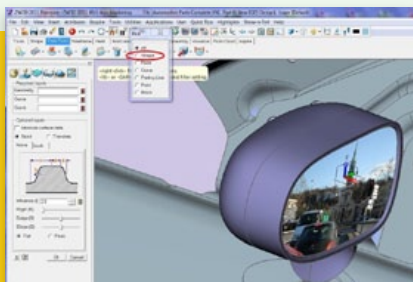
1 Door Skin



2 Zoom in to show the rear view mirror

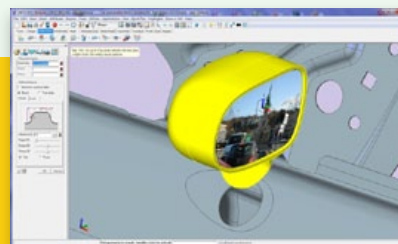


3 Select the Freeform tab and then select the Morph curve to curve icon

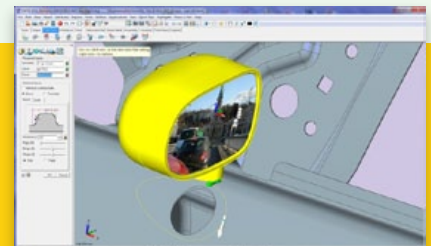


4 I then Set the Selection Filter to Shape so that I can Select the rear view mirror body, without ZW3D trying to select edge curves or surfaces.

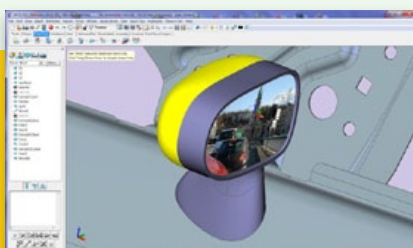
You can see the rear view body in location and the curve to define the transition base.



5 Rear view mirror body is selected and highlighted in yellow.



6 Select the first and second curves to define the morph, indicated by the green and white curve direction arrows and highlighted in yellow.



7 We then Select OK to display the finished product.

### Optional Inputs

#### Minimize surface data

Use this option to reduce the number of control points used in the modified (i.e., morphed) surfaces. This option slows down the Morph command but dramatically reduces the control point density of the resultant surfaces. Thus reducing part size and makes the surfaces and shapes much quicker to modify with subsequent modelling operations.

This is just one example of a very powerful module of ZW3D.



Please contact Steve Corrigan on 1300 965 690 or [steve@compumod.com.au](mailto:steve@compumod.com.au) for further information on ZW3D.