

## No Separation using MPC's

By Doug Oatis

So there I was, preparing weeks before teaching an 'Advanced Contact' course, when I noticed that the "new" MPC formulation could be applied to both Bonded and No Separation contact. Alright, so maybe it was the night before the class, but the fact of the matter is that the MPC formulation is applicable to BOTH contact types.

Then, for some reason, I immediately thought of the movie 'Cliffhanger'. If only Gabe Walker



(played by Sylvester Stalone) could have held on to Sarah (Michelle Joyner) with constraint equations, then she would have lived. If he set his grip to Bonded MPC, then maybe he could have pulled them both across the safety line. Even

better, if his grip was set to No Separation MPC, Sarah could have climbed up and rigged a prusik to the safety line (if she was carrying the appropriate cordelette). Unfortunately for Sarah, and the immediate friendship

*(Cont.. on pg. 5)*

## Delving into NUMMRG

By Eric Miller

NUMMRG is one of those ANSYS commands that everyone knows, and everyone uses, but that few people know inside and out. It is so obvious how to use it for its primary use, merging keypoints or nodes that are coincident, that most of us never look at all the additional capabilities and options available. Also, as more and more users "grow up" using the GUI or Work-

bench, they never get a chance to study all the options on commands.

Merging entities can be a very helpful thing. It reduces the size and complexity of your model, may eliminate the need for generalized contact to "glue" things together, and help in the creation or repair of geometry. But it can also be dangerous. If you merge geometry that is too far apart, the internal

Boundary Representation of your geometry gets messed up and future operations will probably fail. So understanding this command inside and out is very important.

### The Basics:

It is always good to begin with some basics. The command is a bit hidden under Preprocessor->NumberingCtrls->Merge>Items in the GUI. The command has a typical syntax for ANSYS:

NUMMRG, Label, Toler, Gtoler, Action, Switch

To use the command, you usually use NUMMRG,KP or NUMMRG, Node. For nodes, this will merge any selected nodes whose distance is less than 1.0e-4 retaining the lowest entity number

*(Cont. on pg. 4)*

### Table of Contents

No Separation using MPC's .....	1
Delving into NUMMRG .....	1
View Orientation and Zombies .....	2

# View Orientation and Zombies



Minneapolis Zombie Pub Crawl

By Rod Scholl

One of the tricks in automating post-processing in ANSYS is getting the right view angle. For the folks who used rocks for chairs and didn't have the luxury of the GUI, setting up the snapshots was part of the skills needed. But with the GUI, and log file, even most power-users couldn't rattle off the command to view an isometric view from anything other than the XYZ direction with Y pointed up. But, one could still script and run batch and automate desired images. Typical approach is to set up the image using a pan/zoom/rotate then copy

and paste some the /VIEW and /ANG commands from the log file into the script. Easy enough.

### Enter Workbench Snippets:

There's seems something kinda silly about firing up black-screen ANSYS in order to determine the /VIEW and /ANG commands (especially for simple views like -X,Y,-Z or what-have-you) and then pasting those into workbench. So like a swarm of zombies we need to reanimate our pre-GUI knowledge.

### Rise... RISE!!!!

So we can learn how to look at a triad and convert it by inspection to APDL commands for use within a Workbench snippet and forgo launching black-screen ANSYS. It is of course an approximation --but I think you'll be able to live with the results. Thus, step by step,

brain by brain, we will re-consume... the... the... I dunno, the metaphor was really an excuse to show these images and the chant I'm told was shouted repeatedly:



What we'll need is a /VIEW command (the viewing vector) and an /ANG command which is also fairly easy. The /VIEW command will be of the form:

```
/VIEW,,X,Y,Z
```

We'll enter a 1 in (Cont. on page 3)

PADT publishes another periodical under the name [SWAU \(Southwest ANSYS Users\)](#). Eric Miller does most the writing for this one -- and some information is too valuable to not include here in the Focus. Excerpts from his recent article "CAD & Workbench: Sorting out the Options" include the helpful table below. [See the article](#) for the full details and text.

	Type	Solids	Surfaces	Curves	Attributes	Names	Materials
CATIA V5 (Capri Gateway)	Plugin	Yes					
DesignModeler	Plugin	Yes	Yes	Yes		Yes	Yes
Inventor	Plugin	Yes			Yes	Yes	Yes
Mechanical Desktop	Plugin	Yes			Yes	Yes	
OneSpace Designer Modeling	Plugin	Yes	Yes				
ProENGINEER	Plugin	Yes	Yes		Yes	Yes	Yes
Solid Edge	Plugin	Yes	Yes		Yes	Yes	
SolidWorks	Plugin	Yes	Yes		Yes	Yes	
Unigraphics	Plugin	Yes	Yes		Yes	Yes	Yes
ACIS	Reader	Yes	Yes				
CATIA V4/V5	Reader	Yes	Yes				
IGES	Reader	Yes	Yes				
Parasolid	Reader	Yes	Yes				
STEP	Reader	Yes	Yes				

"The table below lists the formats supported by Workbench at V11. It also gives a brief summary of what does and does not come over from the geometry file into Simulation. Pretty much all types of geometry come into DesignModeler, so if you need surfaces or curves from an unsupported format, go through DM."

(View Orientations. cont...)

the corresponding slot for the longest of the three Triads, X, Y or Z. Then we'll enter a multiplier for the other triads lengths. See examples below:

- Axes are Equal lengths: /VIEW,,1,1,1
- Z is 1/3 as long as the X and Y: /VIEW,,1,1,3
- X is 1/2 as long as Y, Z is 1/8<sup>th</sup> as long as Y: /VIEW,,2,1,8

Next we'll consider the signs. If you are looking down the increasing axis direction, use a negative sign. If you are looking against the axis, toward the origin, use a positive sign. This is done for each axis. See the triads and resulting signs in the image to the right.

Finally we learn to use the /ANG command. In the above examples, Y is oriented towards the top of the screen/page, corresponding to /ANG,,0. See the two examples to the lower right. Thus we can determine the approximate angle of the Y axis off the vertical direction (counter clockwise is positive) and use that for our /ANG command:

/ANG,,angle from vertical

Oh, and for zoom, of course a /AUTO,,1 will fit to screen, though I often follow this up with a /DIST,,0.85,1 to make better use of real estate.

Try it out – it's really fairly accurate. Not perfect, but perfect enough. Now that you have completed your zombie training, reward yourself with a cupcake!

**Braiiiins!!!!**



A creation by [Tiny Temptations](#)

<p><b>X is positive Y is positive Z is positive</b></p>	<p>ANSYS NODAL SOLUTION FEB 6 2008 23:03:37 STEP=1 SUB =1 TIME=1 USUM (AVG) RSYS=0 DMX =.004119 SMX =.004119</p>
<p><b>X is positive Y is negative Z is positive</b></p>	<p>ANSYS NODAL SOLUTION FEB 6 2008 23:00:24 STEP=1 SUB =1 TIME=1 USUM (AVG) RSYS=0 DMX =.004119 SMX =.004119</p>
<p><b>X is positive Y is positive Z is negative</b></p>	<p>ANSYS NODAL SOLUTION FEB 6 2008 23:02:41 STEP=1 SUB =1 TIME=1 USUM (AVG) RSYS=0 DMX =.004119 SMX =.004119</p>
<p><b>/ANG,,90</b></p>	<p>ANSYS NODAL SOLUTION FEB 6 2008 23:07:58 STEP=1 SUB =1 TIME=1 USUM (AVG) RSYS=0 DMX =.004119 SMX =.004119</p>
<p><b>/ANG,,-45</b></p>	<p>ANSYS NODAL SOLUTION FEB 6 2008 23:08:55 STEP=1 SUB =1 TIME=1 USUM (AVG) RSYS=0 DMX =.004119 SMX =.004119</p>

(Delving into NUMMRG. cont...)

of the merged numbers. For keypoints that are not attached to lines, things work the same. But if they are connected to lines, things get more complicated. If those lines are connected to areas and then volumes, it gets even more complicated. We'll cover that below when we talk about Gtoler.

### Label:

Most people use this command for Nodes and Keypoints, but it also works on Elements (ELEM), Materials (MAT), Element Types (TYPE), Real constants (REAL), Couples (CP) and Constraints (CE). Or you can say ALL and get everything. For nodes and keypoints it looks at distance between entities, but for MAT, REAL and CE it compares the values specified as arguments to those definitions. For ELEM, TYPE and CP things must be identical for the merge to take place.

### Toler:

As you would imagine, the most important knob on this command is the tolerance. The default value is 1.0e-4 for nodes and keypoints, 1.0e-7 for Labels of MAT, REAL and CE. You can change it to any value you want, larger or smaller, but do know that if you make it too big, you might merge more than you want, or do a merge that doesn't make sense.

### Gtoler:

As mentioned above, things get tricky when lines are attached to keypoints. The keypoints only get merged when each of the X, Y and Z component distance between keypoints is below Toler AND the ac-

tual distance is less than GToler OR the distance is less than 1.0e-5 times the length of the longest line attached to the keypoints being selected. This is complicated and you should read the manual entry for NUMMRG to get your head around it. This is so tight because if you merge things that are further apart, and you merge them, Boolean operation will probably not work any longer because lines don't sit on areas or keypoints are not close to lines. This is referred to as "sloppy" geometry in CAD systems and it can cause nightmares.

Because of this it is strongly recommended that you not use GToler unless you really need to. Instead, you should go back to your CAD geometry and try and move your geometry so it is coincident. If you can not do that, we recommend that you look at using CADFix <link>.

One thing that is a bit tricky is figuring out how far apart lines, areas and volumes are. Since these entities are not a single point, the distance between two of them must be defined, and we have not been able to figure out how ANSYS does it. So trial and error is important, and you should always save before merging geometry!

### Action:

By default, NUMMRG just goes and merges what you want it to merge. An action argument of SELE allows you to select nodes that would be merged without doing the merge. That is not a type – it only works on nodes and not on keypoints or other entities. But still, doing a NUMMERG,node,,,sele is very useful and a handy way check

things before you make them permanent. It is also a nice trick for finding nodes close to one another.

### Switch:

The merge command does not move the new entity to an average position. By default is simply keeps the entity with the lowest number and replaces all references to higher numbered entities with the lowest entity number. You can switch to using the highest numbered entity by specifying HIGH for the Switch argument.

### Thoughts:

This is just a quick overview of what is in the command. If you use it beyond the usual, you should read the full documentation and play with the command till you understand how it works. It is a very good idea to always save your DB to a temporary file before you execute a NUMMRG unless you are really confident things will go well.

## Computer Benchmarks

In addition to [PADT's benchmark suite](#), ANSYS inc. has a benchmark site with a focus on high performance computing (HPC).

From the [press release](#):

"Performance results for the suite of benchmarks have been generated by AMD, HP, Intel, Mellanox Technologies and other partners, and they are available on the [ANSYS Web site](#)....including new quad-core processors from Intel and AMD, as well as the new ConnectX InfiniBand adapters from Mellanox.

(No Separation with MPC's, cont...) of Gabe and Hal Tucker (Michael Rooker), only a penalty-based grip (muscles acting as springs) was available. I know, quite a stretch for a comparison.

Anyway, the MPC formulation for 'No Separation' behavior makes

## Channel Partner Combination

ANSYS, Inc.... today announced that five of its North American channel partners have merged to become SimuTech Group.... The newly formed company includes STI Technologies from Rochester, New York; JLR The Engineering Solutions Co. based in Everett, Washington and Denver, Colorado; Ohio Computer Aided Engineering with offices in Cleveland and Cincinnati, Ohio; Advanced Engineering Technologies in Atlanta, Georgia; and ROI Engineering from Toronto and Montreal, Canada.

perfect sense. Contact elements can already detect normal vs. tangential direction, without any input from the user. This makes it very easy to create the internally generated equations that only couple one DOF.

But before you break out your bolt guns (see the movie to find out what I'm talking about) and fire into the air in celebration, there are a few limitations to using MPC for No Separation contact. First, your contact pair must be initially in contact. The MPC formulation will not detect a closing gap and write constraint equations on the fly. The MPC formulation will also not work with element birth/death, which makes sense considering the first limitation.

Now you might be wondering what's so great about

MPC formulation (and possibly what's so great about Cliffhanger). SPEED! If your contact pair is initially closed, and it makes sense to use No Separation, there are significant speed enhancements over penalty-based methods.

On this simple test model, I have a cantilever beam with a block resting on it. In load step 1, I slide the small block along the beam. In load step 2, I lift upward on the small block. I ran this model on a Dell Latitude D531, AMD Athlon 64X2 702 MHz, 2GB RAM, time stats are shown below. As you can see, there is over a 2x speed-up in elapsed time using the MPC-based formulation.

	MPC-Based	Augmented Lagrange
CP Time [s]	244.234	501.250
Elapsed Time [s]	138	282

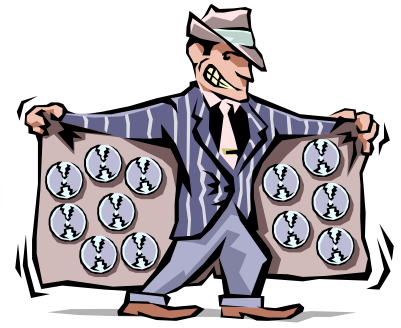
### Upcoming Training Classes

Month	Start	End	#	Title	Location
Mar '08	3/17	3/18	501	ANSYS/LS-DYNA	Tempe, AZ
	3/26	3/28	902	Multiphysics Simulation for MEMS	Tempe, AZ
Apr '08	4/2	4/4	101	Introduction to ANSYS, Part I	Tempe, AZ
	4/7	4/8	107	ANSYS WB DesignModeler	Tempe, AZ
	4/9	4/11	401	Low Frequency Electromagnetics	Tempe, AZ
	4/14	4/15	604	Introduction to CFX	Tempe, AZ
	4/21	4/22	201	Basic Structural Nonlinearities	Tempe, AZ
	4/23	4/24	204	Advanced Contact and Fasteners	Tempe, AZ
May '08	4/28	4/30	152	ICEM CFD?AI*Environment	Tempe, AZ
	5/1	5/2	104	ANSYS Workbench Sim. Intro	Las Vegas
	5/5	5/6	100	Engineering with FEA	Tempe, AZ
	5/8	5/9	107	ANSYS WB DesignModeler	Tempe, AZ
	5/12	5/13	205	ANSYS WB Simulation Dynamics	Tempe, AZ
	5/14	5/14	702	ANSYS WBDesignXplorer	Tempe, AZ
	5/19	5/20	207	ANSYS WB Simulation-- Structural Nonlinearities	Tempe, AZ
5/22	5/23	302	ANSYS WB Simulation -- Heat Transfer	Tempe, AZ	

## Online Resources

- Did you know PADT has extensive capabilities in Rapid Prototyping? [Learn more!](#)
- It's been a few years since we've mentioned [www.xansys.net](http://www.xansys.net), Sheldon's helpful website. If you aren't familiar with it, its a must-have resource.
- If you use APDL, you'll probably dig the [\\*GET cheat sheet](#). Download and print your copy of PADT's handy tool.
- The library of material properties at [www.matweb.com](http://www.matweb.com) seems to have finally fixed their search engine. MUCH better!
- Explore [Belcan's ANSYS Support Page](#) -- even if they are not your support provider explore their FAQ, Technical library, and more.

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**Seminar location**  
PADT's Tempe Office  
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