Datapoint

Reporting on developments in material properties for engineering design

NEW CAPABILITIES

DatapointLabs Brings ANSYS In-house to Provide Better Accuracy

In the development of material model parameters for CAE programs, there is often the question about whether the material model is valid for the CAE code that it is intended for. Typically, most CAE programs have limited means to fit material model parameters to test data. In many cases, the curve fitting is complex and requires a level of expertise that is typically not available to the analyst. Thus, variability exists in this process and the quality of the material model parameters can differ depending on who is doing the regression, and on the tools being used.

The latest release of ANSYS has newly developed material model fitting capabilities. We embarked on a study to compare the differences between model parameters developed using ANSYS routines, and those developed by hand using generic multi-variable regression programs. The results of this study are presented below based on test data measured on a typical rubber and applied to a hyperelastic material model.

The validity of the material model parameters was tested by recreating the tensile and compressive test set-ups within ANSYS. The compressive model was created using SOLID185 elements. Measured and predicted stresses were compared at a strain of 30%. Mooney-Rivlin coefficients were generated using the ANSYS curve-fitting utility and a generic curve-fitting program. From Fig. 1 below, the ANSYS coefficient-based results differ from actual test results by 10.3%, while the results from the generic program is off by 38.7%.

For the tensile test case, PLANE183 elements were used. Again, stresses were compared at 30% strain. Fig. 2 shows results from simulations using Mooney-Rivlin coefficients generated using the ANSYS curve-fitting utility, compared to the generic curve-fitting program. The ANSYS coefficient-based result differs from actual test results by 10.0% while the results from the generic data analysis program give a difference of 42.2%.

Results are based on single runs with one element type used as well as one strain.

Article continued on Page 3

FOCUS:

Technology Integration

As virtual product development (VPD) matures, the emphasis shifts to the integration of associated elements, to speed up and ease the implementation of the technology. With the growing use of diverse materials, one such area is that of material properties data management. On page 3 is Part One of a two-part article that defines the wish list along with a brief overview of current technology. The next issue of Datapoint will highlight a complete solution under development.

From another angle, DatapointLabs now has in-house capabilities to provide you with complete material data models for ANSYS, prefit and validated using ANSYS, as presented in the cover page article.

We present highlights from 2002 events, new partnerships and TAP expansion: *TestPaks*™ for PAM-CRASH and PAM-FORM. Plus a book review of Beaumont, Nagel and Sherman's "Successful Injection Molding".

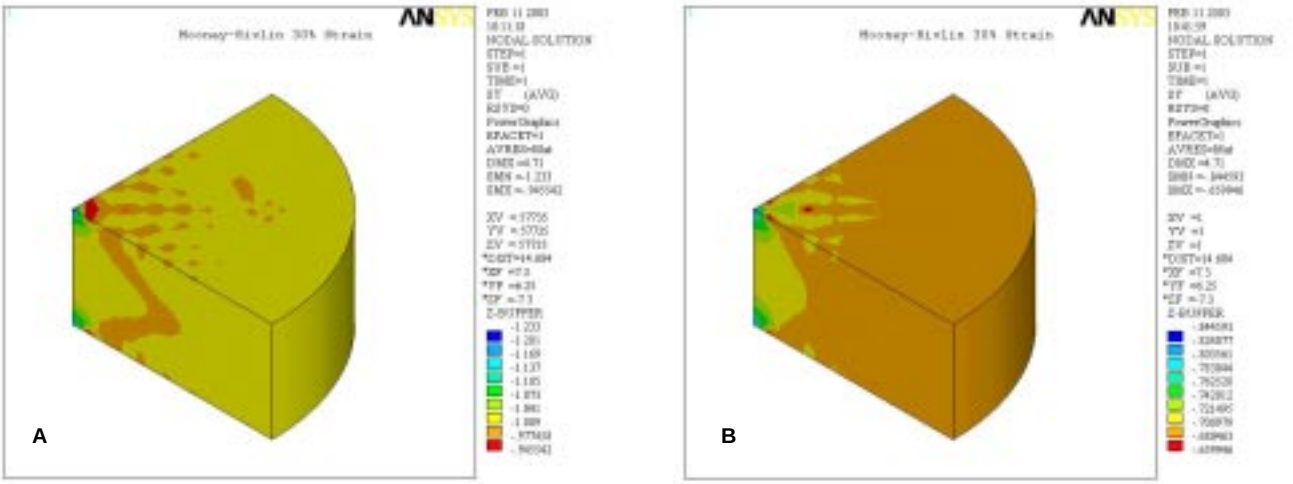

Figure 1. Verification of compression test using Mooney-Rivlin coefficients derived by ANSYS (A) and manually fit with generic curve-fitting programs (B)

2003 EVENTS CALENDAR

DatapointLabs to sponsor iMug'03

DatapointLabs will be attending iMUG'03 as a sponsor, April1-3, Pittsburgh. Meet Hubert Lobo and S. Scott Kumpf at the Sponsor Event.

Upcoming events

SAE 2002 World Congress, March 3-6, Detroit, MI

Moldflow 2003 iMUG Conference, April 1-3, Pittsburgh, PA

SPE ANTEC 2003, May 4-8, Nashville, TN

Fluent Users Group Meeting 2003, May 5-7, Manchester, NH

ABAQUS User's Conference, 2003, June 4-6, Munich, Germany

NAFEMS World Congress 2003, May 27-31, Orlando, FL

NPE 2003, June 23-27, Chicago, IL

EVENTS 2002: REVIEW

DatapointLabs Has This Fellow...

DatapointLabs President, Hubert Lobo was recognized as a pioneer for his work in the development of techniques to represent polymer behavior in CAE by the Society of Plastics Engineers. He was named "Fellow of the Society" at ANTEC 2002 in San Francisco, last year.

With a strong continued commitment and focus on meeting material issue needs of the CAE and FEA community, DatapointLabs makes every effort to be present at our CAE partner events:

iMUG'02, MA

ANSYS User's Conference 2002, PA

ABAQUS User's Conference 2002, RI

Polyflow UGM 2002, Belgium

CAD-FEM User's Meeting, Germany

AMERIPAM 2002, MI

We bring back from these events a better understanding of the needs of the virtual product design community.

TAP EXPANSION

DatapointLabs Partners With ESI

DatapointLabs is has signed an MOU with ESI-Group. The new MOU allows DatapointLabs to develop *TestPaks*™ for ESI software users.

Look for announcement of availability of these new *TestPaks*™ for PAM-CRASH and PAM-FORM in the coming weeks at www.datapointlabs.com. Meanwhile, if you have a need, please call our Sales Team

1-888-DATA-4-CAE.

DatapointLabs Deepens Ties With ABAQUS

In a new announcement, the relationship between DatapointLabs and ABAQUS is strengthened by a new agreement to meet mutual clients needs. An extensive array of *TestPaks*™ for ABAQUS can now be viewed directly at the ABAQUS web site *TestPaks*™ can now be ordered on-line at www.datapointlabs.com. DatapointLabs will bring the ABAQUS software in-house to facilitate an enhanced level of support for *TestPaks*™ for ABAQUS.

BOOK REVIEW

Successful Injection Molding

Beaumont, Nagel and Sherman

Hanser Publications (2002)

ISBN 3-446-19433-9

There has been a long standing need for a book that describes the process of injection molding using the insights developed from twenty years of computer aided engineering (CAE). The authors, all veterans of injection molding CAE, have filled this need with their book. "Successful Injection Molding" is a lot more than a book about injection molding CAE. It is clear at this stage that CAE is a tool, which, if well handled, can provide excellent results. That being said, a successful implementer of CAE for injection molding must have a range of insights into the diverse idiosyncrasies of this enormously complex manufacturing process. The book is successful in clearly addressing these issues.

CAE has probably done more for the understanding of the injection molding process than it has for any other application for which it has been applied. With CAE, a designer can visualize complex transient events that integrally affect the processability, shape and performance of the final product being designed. The authors lead the reader through the molding process as seen through the eyes of the CAE program, interpreting the observed behaviors along the way. The book does not stop here, however. Recognizing that there are still many aspects that cannot be well handled in simulation, the authors introduces a healthy amount of practical advice on issues such as the placement of weld lines, flow hesitation and numerous other factors that can affect part performance. Liberal use of simulation pictures also help the reader to visualize the phenomena under discussion.

In the Introduction, a methodology is presented for implementation of a design process that includes CAE, which helps ensure that all parties involved are clear about their role in the process. A description of basic polymer behavior and the injection molding process follows. Chapter 4 gets into design, presenting part design guidelines. Issues related to the mold design are also covered including a practical treatment of runner systems, gating designs and cooling systems. In Chapter 6, CAE is used to understand the filling process, and the understanding is used to develop design and process strategies to eliminate flaws in the product. The rest of the book is devoted to injection molding CAE. The pros and cons of the different CAE approaches are discussed followed by guidelines on optimal processes to use when performing simulation. Detailed chapters on filling, post-filling, mold-cooling and shrink/warp analysis follow. The book is accompanied by a CD-ROM containing color figures and computer generated flow animations that are integral to the understanding of the injection molding process. A spreadsheet for determining thicknesses for shell surfaces with poor aspect ratio is also included.

-Hubert Lobo

DATA MANAGEMENT

Sourcing Material Data for Virtual Product Development-Part 1

With global spread of virtual prod uct development (VPD) and a multitude of modern materials, enterprises are facing technological challenges in storing, managing and seamlessly exchanging material property data between interested parties and collaborators. Our readership represents a diverse cross-section of users of material properties across automotive OEMs, Tier 1-n suppliers, aerospace, defense, resin manufacturers and high technology industries. This article highlights the needs of the VPD community with regard to “materials issues.”

“We have subscribed to online databases that boast of properties for >30,000 materials, but we cannot find the properties we need!” is a common complaint. Online databases serve as vast collections of simple, comparative material properties, geared primarily towards providing a material selection tool. They often do not contain the representative 'design properties' of interest for VPD. Storage and representation of the complex interdependent behavioral characteristics of materials for VPD remains a major challenge. No single repository currently handles such data diversity. Hence, designers within an enterprise utilize multiple sources of input data, creating the risk of inconsistent material representation that could adversely affect downstream collaborative design work. An incorrect representation of material behavior can be fatal for an involved multi-participant VPD.

Accordingly, the new need is defined to:

- create a material data management system that can handle diverse collections of application-specific properties ranging from simple linear to complex non-linear data
- warehouse quality data from different certified and identified sources
- provide secure filing cabinets for internal and proprietary data
- permit easy, but secure exchange of materials data between collaborators anywhere
- allow data access to be controlled by the ‘data owner’
- export material model parameters to CAE programs
- include technically competent customer support for non-linear material models.

Subsets of these needs are satisfied by providers such as GE Plastics or Moldflow that have introduced plastics databases containing material properties for VPD. However, these properties are available to specific constituencies only. They do not offer broad based interoperability.

The free CAMPUS plastics materials database has existed for many years. It has acted as a repository of data that material suppliers do not mind sharing with the public. It is primarily intended as a material comparator, not a source for design properties. It does not present VPD communities with a warehousing solution for the actual materials that they use. It allows output suitable for limited simulation programs. Matweb is similar in being free and has similar limitations. Data fidelity and traceability are issues of concern when designers in enterprises variably use multiple free databases.

In the “for fee” category, the IDES plastics material database has assimilated the CAMPUS collection in addition to its own, along with a search engine to rank and select materials. However, the data is still comparative and the interface to design programs, weak. MVision presents a collection of >30 databases with limited connectivity to linear CAE applications. This results in a vast sea of data so that finding the right data becomes difficult once again. Further, there is no guarantee that once the fees are paid the properties of the material of interest exist within.

While it is clear that a number of options do currently exist for serving material data, these sources either lack the depth, breadth or interoperability for this major market. None of them offer a scaleable, comprehensive and seamless solution for all the collaborative developmental platforms. They do not provide tools for control of information that is “enterprise-specific,” or support the highly sophisticated needs of the VPD community.

-Renu Gandhi.

Next issue - Part 2: a complete solution.

COVER STORY CONTD.

...Material Model Fits Using ANSYS

Article continued from Page 1

The element types selected above have been designed specifically to be used with the ANSYS curve fitting program. The quality of the simulation results could depend on how well the material model fits the test data. Higher node elements may produce different results. Although there is a great difference in results much more research must be done in the use of different elements, materials, loads, and constraints. It must be noted also that hyperelastic models typically do not fit data well over entire regions. If the strains seen in the actual application are low, a model fit in this manner may perform poorly. The proper approach in this case, is to restrict the range of data submitted to the regression program so that a better fit is obtained for the region of interest. Analogously, issues such as precycling or first deformation (see Datapoint Spring 2001 Issue) must also be considered.

We conclude that for the test case studied, the ANSYS data-fitting program yielded test parameters that work well in the ANSYS simulation when used with the appropriate elements. DatapointLabs has now internalized this methodology so that all material model parameter development for ANSYS will now be performed within ANSYS 7.0. A new service is also available to validate the material models to add an additional dimension of confidence to the end user. The comparability of the simulation to the actual experiments performed will be demonstrated.

-Brian Croop and Hubert Lobo

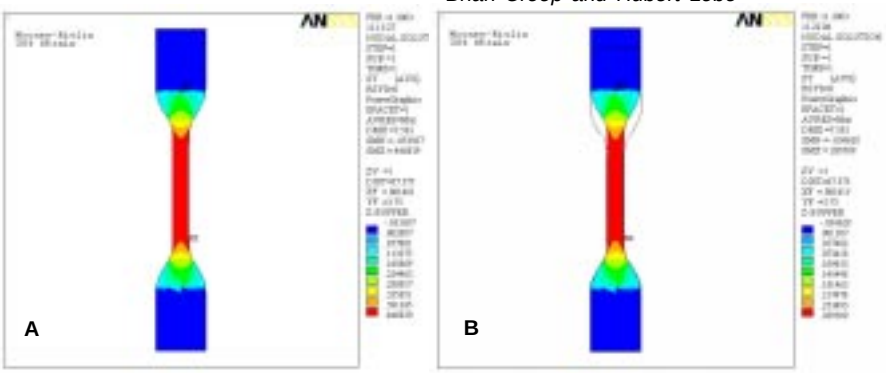

Figure 2. Verification of tensile test using Mooney-Rivlin coefficients derived by ANSYS (A) and manually fit with generic curve-fitting programs (B)