ASME

COMPUTERS & INFORMATION IN ENGINEERING DIVISION

Summer 2007 Fred Proctor, Editor

Chair's Message

Imre Horváth, Chair 2006-2007.

Rio Hotel Las Vegas, Nevada USA – Venue for the 27th CIE Conference

On behalf of the Executive Committee of the Computers and Information in Engineering Division, I would like to greet you all, our senior and junior affiliates, leaders and members of the Technical Committees, and our international representatives. The fiscal year 2006/7 has been an exciting and busy year for all of us, with many challenges, but also with many achievements. ASME has continued the process of consolidating its new organizational structure and operational framework with the goal of responding to the rapidly changing global technological environment, and supporting its membership to fulfill the new requirements of the forming knowledge society. Working as one of the more than 800 member units of the Knowledge and Community (K&C) Sector, the Division formulated its specific goals in line with the endeavor of ASME, and worked hard to realize them for the benefit of the membership and the Society.

In addition to successfully organizing our yearly Computers and Information in Engineering Conferences (CIE '06 and '07) and contributing to the International Mechanical Engineering Conference and Exhibition (IMECE), some of our main goals have been: active leadership on both executive and technical committee levels, increasing the membership with special attention to early carrier engineers, outreach to industry and geographical sections, collaboration with leading international conferences, increasing the number of CIE fellows, collective participation in leadership training conferences (LTC), enhancement of the work of the Technical Committees, and forming a vision about the future of the CIE Division. A lot has been done to achieve these goals - the first results can already be seen, but a lot of work is left for the coming years.

As far as CIE '07 is concerned, we are going to have a successful conference again. Almost 120 high quality papers have been accepted after a strict peer review process. This conference is the largest source of income for the Division. There was a proposal to organize special sessions on emotional engineering. This topic raised a wide interest and contributed at least four sessions to the conference program, discussing various informational and computational aspects of this important and unexplored field of interest. Several other special sessions and panels will complement the professional program. I would like to take the opportunity to thank the hard work of the Conference Executive, Dr. Chris Paredis, and the Program Chair, Dr. Ravi Rangan.

We have started thinking about the intensification of the work of our Technical Committees, possible sunset or redefinition of some old ones, and establishing new ones on currently emerging topics. Our current Technical Committees are Computer-Aided Product Development (CAPD), Engineering Information Management (EIM), Computers in Electromechanical Systems (CINEMAS), Computers in Education (CIE), Non-Traditional Computing (NTC), Internet-Aided Design, Manufacturing and Commerce (IADMC), Energy Systems (ES), Computational Technologies for Engineering Sciences Applications (CTESA), and Virtual Environments and Systems (VES). Needless to say, the activities and programs of the Technical Committees are the engine of the Division, and play a crucial role in furthering the goals and objectives of the Division and its membership. The goals are to involve more students and early carrier engineers, to establish bridges to regional sections, to form interest groups, and to create platforms for communities of practice. We apply also the principle of "Continuity and Change," that is, we are maintaining the professional and social values of the past and continuing with the best practices, but we are also working to create new opportunities, products, and platforms.

The Division operates in one of those six industry sectors that ASME has identified as representing new growth areas for members (pressure technology, energy, biopharmaceutical, waste management, homeland security, and computer hardware and software). This increases not only our opportunities, but also our responsibilities. The main professional aim of the Division is to stimulate and to contribute to the development, acquisition, and dissemination of technical knowledge related to research and application of methods and tools of applied information technology, to provide opportunities for engineering practitioners to network and to exchange ideas, and to promote the advancement and professional carrier development of our members. Several members are making significant contribution to the ASME Journal of Computers and Information Science and Engineering, either as associate editors or as authors. Other colleagues contributed to international conferences as invited keynotes and discussion panel members. This has increased the international visibility of the Division, but we will continue to create new products that may even bring about financial benefits.

The CIE Executive Committee at the 2007 Leadership Training Conference in Houston in March. From left to right: Imre Horváth, Fred Proctor, Chris Paredis, Noha El-Ghobashy, Ravi Rangan, John Michopoulos and Shuichi Fukuda.

The Division is healthy from both organizational and financial points of view. Also the devoted and visionary leadership of the Division seems to be granted for the coming years. The Executive Committee has an excellent mix of experts from the industry, government, and academia. Two members of the Executive Committee are located in Europe and Japan. We have recently inaugurated Dr. John Michopoulos as incoming member of the Division's Executive Committee. He successfully managed one of the Technical Committees for years. We are making efforts to recruit new leaders for some of our Technical Committees and will initiate forming new interest groups at the forthcoming CIE '07 conference. As for the future, we hope to attract more female colleagues, and to get them involved in the management of the Technical Committees as well as in the Executive Committee. Being a volunteer and member driven unit, it seems to be important to adapt our portfolio of

services to fit the unique needs of young international engineers, who are in the age group of 20 to 40.

Let me finish my message with a couple of personal words. First of all I would like to thank the ASME staff for their unceasing support, in particular, to Ms. Noha El-Ghobashy. I would like to use this opportunity to thank for the support of Dr. Ken Waldron, the chairman of the Systems and Design Group. But above all, I am the most grateful to the other members of the CIE Division's Executive Committee for our open and friendly relationship, their outstanding cooperation, as well as for the countless fruitful discussions. Chris, Ravi, Fred, Plamen, Shuichi, John, it has been my privilege and I am very pleased to have been working with you in the last five years, and I hope that our cooperation will continue for long. I wish you a lot of energy and wisdom for your future managerial and professional work, as well as many successes for the benefit for our membership and you all.

Prof. Dr. Imre Horváth
Delft University of Technology
The Netherlands

Don't Forget! 27th CIE Conference Sept. 4-7, 2007 Las Vegas, Nevada

The ASME International 27th Computers and Information in Engineering (CIE) Conference will be held on September 4-7, 2007, in Las Vegas, Nevada.

This year's conference provides a forum for enhancing the practice of engineering by understanding the application of emerging technologies that impact critical engineering issues of representation, product design and product development, exchange, management and integration of information throughout the entire engineering product and process life-cycle. A total of 151 draft papers were submitted to the 27th CIE conference, of which 118 were accepted into the final program. These papers cover a total of 12 topic areas aligned with the activities of the CIE Technical Committees. There are two new topics on the program this year: *Emotional Engineering* and *Applications of RFID* — emerging areas in which the CIE Division is at the forefront of research activities.

We are also excited about welcoming our keynote speaker, Tom Lange from Proctor and Gamble, who will inspire us with his views on: "CAE behind everyday products: Innovating how P&G Innovates." In addition, at the CIE conference dinner, which replaces our annual luncheon, we will be engaged by David Burdick with his ideas on "Product Design Technology Megatrends: Engineering Products for the iPod Generation." In addition, CIE will be hosting 4 panel sessions, 2 tutorials, and 4 workshops.

So, join us in Las Vegas in September. As in previous years, it promises to be an exciting event again where the CIE community really shines.

http://www.asmeconferences.org/idetc07

Chris Paredis
Conference Chair
Georgia Institute of Technology

ASME Congress 2007

The ASME International Mechanical Engineering Congress and Exposition will be held in Seattle, Washington USA November 11-15, 2007. This year, ASME is splitting the business and technical content, with IMECE retaining the technical content. Attendees of past Congresses who primarily attended the technical sessions will notice little change.

IMECE is organized into 26 Tracks, with CIE involved in Track 3, Design and Manufacturing, Symposium 10, Information-Based Design and Manufacturing. 28 papers have been accepted in our symposium.

Information on the upcoming Congress is at asmeconferences.org/congress07.

Fred Proctor, NIST

SysML: Supporting Model-Based Systems Design

Contemporary systems engineering projects encompass many different domains of knowledge, exist at increasingly large scales, and consist of multiple subsystems and components. Such systems are subject to the requirements and objectives of many different project stakeholders. Studies generally show that problems associated with the development of satisfactory systems have more to do with the organization and management of complexity than with the direct technological concerns that affect individual subsystems and specific physical science areas. If system designers do not fully understand the

complexity and emergent behavior of the system under development, they might overlook important design details and relationships. Such mistakes can compromise stakeholder objectives and lead to costly design iterations or system failures.

To overcome these problems, the Object Management Group has developed the Systems Modeling Language (OMG SysML™). SysML is a general-purpose information modeling language that allows system designers to create and manage models of physical systems using well-defined, visual constructs. The knowledge captured by a SysML model is intended to support the specification, analysis, design, verification and validation of a complex system.

The specification of the SysML language reuses a subset of UML 2.0 and extends it where necessary. Adopted in November 1997, the Unified Modeling Language is a visual language for specifying, constructing, and documenting the artifacts of software, business models, and other applicable systems. It is a general-purpose modeling language that can be used with all major object and component methods. The language is commonly used during the development of large-scale, complex software for various domains and implementation platforms.

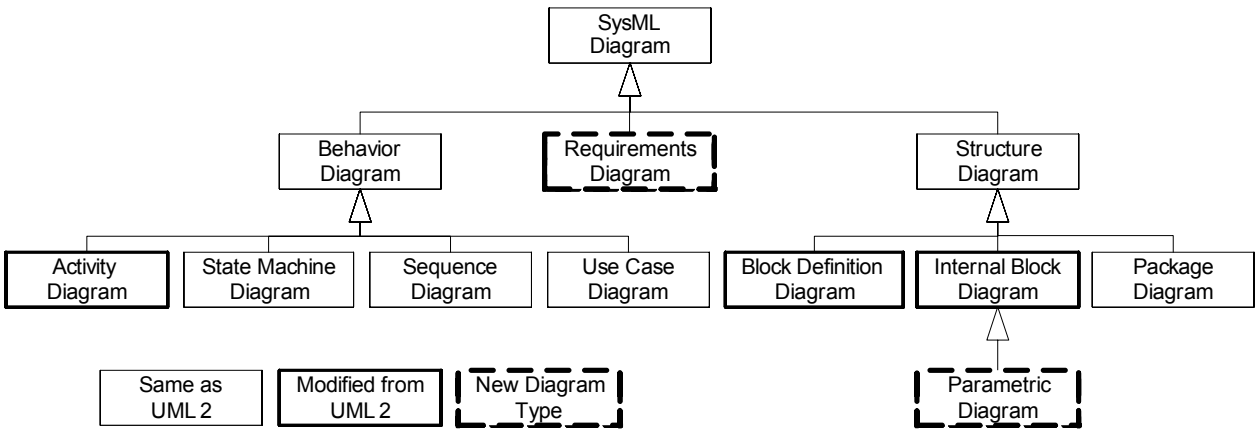
The SysML profile was developed to extend UML for increased support of systems engineering projects. It extends UML in the following manners:

- SysML blocks extend UML classes
- SysML enables requirements modeling
- SysML supports parametric modeling
- SysML allocations extend UML dependencies
- SysML reuses and modifies UML activities
- SysML flow ports extend UML standard ports

The figure below depicts the SysML diagram taxonomy as a graphical representation of SysML's extension of UML. A block with a regular or bold border represents a UML diagram type that has been reused or modified in SysML, respectively. Blocks with a dashed border represent new diagram types, namely, the *requirements* and *parametric diagrams*.

The *«block»* is the basic unit of structure in SysML and can be used to represent hardware, software, facilities, personnel, or any other system element. The system structure is represented by block definition diagrams and internal block diagrams. A block definition diagram describes the system hierarchy and system/component classifications. The internal block diagram describes the internal structure of a system in terms of its parts, ports, and connectors. The package diagram is used to organize the model.

The behavior diagrams include the use case diagram, activity diagram, sequence diagram, and state machine diagram. A use-case diagram provides a high-level description of functionality that is achieved through interaction among systems or system parts. The activity diagram represents the flow of data and control between activities. A sequence diagram represents the interaction between collaborating parts of a system. The state machine diagram describes the state



The SysML diagram taxonomy [adapted from www.omgsysml.org].

transitions and actions that a system or its parts perform in response to events.

SysML includes a graphical construct to represent text-based requirements and relate them to other model elements. The requirements diagram captures requirements hierarchies and requirements derivation, and the satisfy and verify relationships allow a modeler to relate a requirement to a model element that satisfies or verifies the requirements. The requirement diagram provides a bridge between the typical requirements management tools and the system models.

The parametric diagram represents constraints on system property values such as performance, reliability, and mass properties, and serves as a means to integrate the specification and design models with engineering analysis models.

SysML also includes an allocation relationship to represent various types of allocation, including allocation of functions to components, logical to physical components, and software to hardware.

To learn more about the Systems Modeling Language, visit www.omgsysml.org where you can find several introductory tutorials and papers. The SysML movement is quickly gaining momentum with several major software vendors supporting the standard (for a list of vendors consult the web-page above). The Computers and Information in Engineering Division is also contributing to the development of model-based systems engineering tools and methodologies. CIE has recently created a new Technical Committee that is focused specifically on issues related to *Integrated Systems Engineering*. If you are interested in learning more about the state of the art in systems engineering, including such recent developments as SysML, please visit the SysML web site at www.omgsysml.org, or contact the current leadership of the Integrated Systems Engineering technical committee: david.e.lee@ngc.com, chris.paredis@me.gatech.edu, or lirem.tumer@oregonstate.edu.

Compiled by Chris Paredis with contributions from Thomas Johnson, Roger Burkhart, Sandy Friedenthal and the OMG SysML standardization committee.

JCISE Enters Sixth Year of Publishing

In March 2006 JCISE celebrated its 5th anniversary. Since our first issue came out in March 2001, we have produced 23 issues containing 248 articles, of which 195 were full-length research papers. Our average review time is around 2.3 months. Paper submissions have climbed at a steady rate of 15-20% a year. Since our page quota is fixed (400 pages max annually) and our acceptance rates have not changed significantly, our backlog of accepted papers waiting to be published has grown to about 6 months. This is a healthy number since it allows journal publication to proceed on time.

In 2005 we gained a new sponsor: the Design Engineering Division (DED) of ASME became a full partner with the CIE Division to sponsor JCISE. As part of the agreement, DED gets 2 seats on the JCISE advisory board that is responsible for setting policies and approving associate editors. Profs. Bahram Ravani and Alan Parkinson are currently DED's representatives and, as per agreement, the Chairmanship of the advisory board went to DED for the first year. Prof. Ravani served as Chair for the 2005-06 year. This year the Chair will rotate back to the CIE nominee. We look forward to strengthening our ties with several of DED's technical committees, particularly the Design Automation, Design for Manufacturing, and Design Theory & methodology. Best papers from their respective conferences will now have two avenues for journal publication: this journal (JCISE) and Journal of Mechanical Design.

We thank all authors, reviewers and particularly the associate editors who do the bulk of the work. Almost the entire group of founding associate editors is gone after having completed the maximum of 2 terms permitted by ASME. In 2005 Drs. Ravi Rangan and Simon Szykman, our Application Track associate editors, completed their terms, as have Profs. Paul Wright and Kunwoo Lee. Prof. Susan Urban and David Rosen, two of our founding board of editors, completed their terms in 2006. We thank all of them for their valuable service. New appointments in 2005 included Dr. Jan Vandenbrande of Boeing in the area of geometric modeling, Prof. Jim Oliver of Iowa State in Virtual Environments, Dr. John Michopoulos of Naval Research Labs in Simulation, Prof. Leo Joskowicz of Hebrew University in AI/KBS. Also, starting in 2006 we added Prof. SK Gupta of U. Maryland in the area of CAM/CAPP and Dr. Sean Callahan of Boeing Com-

pany and Prof Kincho Law for engineering informatics.

We also welcome Prof. Rich Riesenfeld, School of Computing at University of Utah, as a new member of the JCISE advisory board. He is well known for his pioneering work in computer aided geometric design, a term that is often attributed to him. He will be replacing Prof. Chris Hoffman as one of the at-large members. Prof. Hoffman service to JCISE for the past 5 years has been invaluable and I thank him for his contributions. The other at-large position will be filled by Prof. Paul Wright of UC Berkeley. Prof. Wright is no stranger to JCISE. He is well known for many innovations in the CAM area, the most recent of which is exploiting the power of the Internet to provide manufacturing services.

We need to maintain the high quality of the journal, continue to grow submissions and subscriptions, and to bring new related communities to JCISE. We need to consolidate our relationship with DED and attract more good papers from that community. The challenge is to maintain the sharp focus we currently have on research with applications in mechanical product development. For 2007 we have announced two special issues: one on Engineering Informatics and the other on Advances in Computer aided Manufacturing. We invite you to send papers for these special issues.

I am somewhat concerned about the perception of statistics computed by formulas created by citation services as "quality measures" of journals. I will refrain from commenting on how well these measures actually represent quality, but they have become a fact of life in the publishing world. In 2004, JCISE was accepted into several major citation indices, such as the Extended Science index. We now need to keep an eye on these numbers as they become available and take steps to do well in comparison to our peer journals, despite the disadvantage of size (number of pages published annually).

I invite the CIE community to continue to send us their best papers from CIE conferences, as well as, to consider JCISE for publishing any other quality papers. Thank you.

Jami J. Shah
Editor, JCISE

Emotional Engineering: Life Journey with Machines

Emotional Engineering is attracting wide attention these days. Why? Some people insist that it becomes important because we have to take into emotion into our design in order to cope with quickly diversifying requirements of our customers. Our customers pick up better looking products if their functions are the same. To add more value to our products, we have to consider emotion.

So, some researchers study impressions. Japanese introduced the idea of *kansei* engineering to distinguish one product from another. But these are largely issues of preferences. Yet, how we can clarify our preferences is the great concern in marketing and in engineering. These people pay primary attention to diversification from customer to customer, i.e. spatial diversification.

Others pay more attention to temporal diversification. Sense of value changes from time to time even with one customer. In contrast with quickly progressing globalization, we come to be aware of our own culture. Cultures differ from region to region and from race to race. They seem to be geographically diversified. But it must be stressed that these changes were brought about during the course of time. The differences of our cultures reflect how we lived our life. Cultures are our own identities as our personalities are. Our customers would like to have products to suit their personalities and their cultures. Thus, design is getting more and more diversified and life based.

When we interact with our products emotionally, it is not an impression alone. For example, there are emotional attachments, which are very much connected with stories of our life. Up to now, machines are designed to work in the same way today and tomorrow. Machines are not believed to grow. Machines are supposed to maintain all the design functions all the time and degradation should be prevented.

But is this true? Each machine has its own story with a customer and a customer cherishes its story because it is his or her own story, too. That's why we cannot throw away our old stuff. My auto may not respond well when someone else drives. But it responds beautifully to me. This is something beyond our old mechanical engineering principle that maintains machines should behave the same way regardless of time and place.

We must remember that machines have personalities, too. They also

are living their life. Your car and my car are different. If you drive my car, you feel uncomfortable. If cars are the same everywhere and every time, then you will not experience such discomfort. In spite of our common belief, machines are living and growing. Engineers have forgotten this fact.

Nonsense? If you think so, recall the bathtub curve in reliability engineering. Machines fail exactly the same way as humans. Machines grow and degrade as human do. They are also physical entities. Mechanical engineers deal with physical objects. But the fact that physical entities will follow the principle of action-reaction seems to have slipped out of their minds.

I am afraid we, mechanical engineers, have been trying too much to suppress the physical reactions. This is the point where Mechanical Engineering differs fundamentally from software or non-physical engineering. Our engineering is no other than physical engineering. Reactions differ from object to object. That's very natural. Then we would feel easy because we will be confident they are physical and natural and we will trust our machines. Haven't we been trying to turn them into non-physical entities? We have to remember what we, mechanical engineers, are creating are physical entities, no matter how much portion software will be introduced. There are no questions about that. Then it is quite natural that these objects have physical attributes.

What we have to consider is how we can grow together with these machines. Emotional attachment, for example, will be invoked with the progress of time. If they behave the same way today and tomorrow, they may be convenient but that's all.

You have no stories to share and you can throw them away tomorrow. But if you have shared stories with them and they gradually take to you, you cannot throw them away. It is part of your life. Life is a journey and you traveled with them. Who can?

Others insist that intelligence is very much associated with emotion. EQ is proposed to replace IQ because emotional intelligence should be considered to really understand intelligence.

Our brain is made of a right brain and a left brain. Therefore, it is quite natural we consider not only the left side or logical side of our brain but also the right or emotional side. If engineering is to realize what we have on our brain, then emotion should naturally come in.

It should be noted that "common sense" has another meaning in the old Greek age. Today "common sense" means "social common sense" as every body knows. But Aristotle defined "common sense" as "sensus communis" which integrates all of our senses together thereby leading to adequate understanding of the situation and to appropriate judgment, which our individual sense alone cannot do. He insists that "sensus communis" integrates emotion and intelligence. When we talk about emotional intelligence, we should remember that it stems from the old Greek age. Yes, there is nothing new under the sun.

Today, our engineering seems to lean too much toward the left side of our brain activities. We have to recall that our brains are made up of right and left ones and they work together. "Gesunder Menschenverstand" or "Gemeinsinn" is very important in design and in engineering.

Donald Norman points out in his book "Emotional Design" that in the old days, our machines were very simple so that people knew how they would work. Machines worked as they expected. Therefore, people felt comfortable and trusted them.

But now machines are getting more and more complicated and what makes things worse is software is coming in so that people cannot easily tell how they will behave. Machines do not behave as people expect so that people began to lose trust in them.

Reliability is important to describe how well the machines will perform. Very often it is discussed with numbers. But numbers do not have any meanings to our customers. Numbers are important, but that's for engineers, not for customers. Engineers often forget about this.

Why do people like to drive a car? Cars are very dangerous in terms of numbers. But everybody trusts cars. People feel they can control their cars. People buy cars because they have trust in cars. Cars are very complex and the environments or conditions change very widely and frequently. A car is a typical example of a today's machine which is getting more and more diversified and which is exposed to extensive and frequent changes in situations.

There are some engineers who attempt to automate all the driving. You just get in and your car will take you to your destination. Do you buy such a car or a machine? I

would not. What's the difference between this automated car and a moving walkway? Will you buy a moving walkway? Never! I would not pay a dime for such a machine.

Why do people love cars and love to drive? Why do some people say that their lover is waiting at the airport and get back home with their lover, BMW? Why do some people drive their Harley-Davidsons together in Milwaukee?

Drivers communicate with their cars. They are not just giving a command or a signal. They are emotionally communicating with their cars and they are exerting their "common senses" so that they can drive beautifully. That's why they feel they know their cars and they call them "My darling" and trust them all the way.

In fact, they do not know anything about their cars. Even for an engineer, it is very hard, not to say impossible, to describe all about a car. When I picked up an internal engine as my graduation thesis, my supervisor told me, "Shu, an engine is a living thing. It changes everyday. It is not an object for engineering research." He was an authority on engine research. His remark surprised me very much. I did not expect to hear such words from him. But later I came to realize that there are so many factors involved in designing and operating an engine, "engineering sense" is what I needed most to study an engine. What I needed was Aristotle's "common sense". I believe that is what my supervisor would like to tell me.

Drivers enjoy exerting their "common senses". Other machines come to be operated in the similar conditions as cars. Then, isn't it time we should develop a methodology where we can work our "common senses" better so that we can overcome the unexpected situations together with our machines?

It would be extremely difficult to design a machine that can cope with any or unexpected situations. But if a human operator or a driver can understand the situation very correctly, then he or she can make adequate judgment and act properly. This is the problem of man-machine team working. Man and Machine should work together well as a team.

There are many other issues and challenges in emotional engineering. Intelligence and emotion should go hand in hand together. But in a nutshell, what is important is a sense of proportion, as Mr. Chips pointed out at Brookfield.

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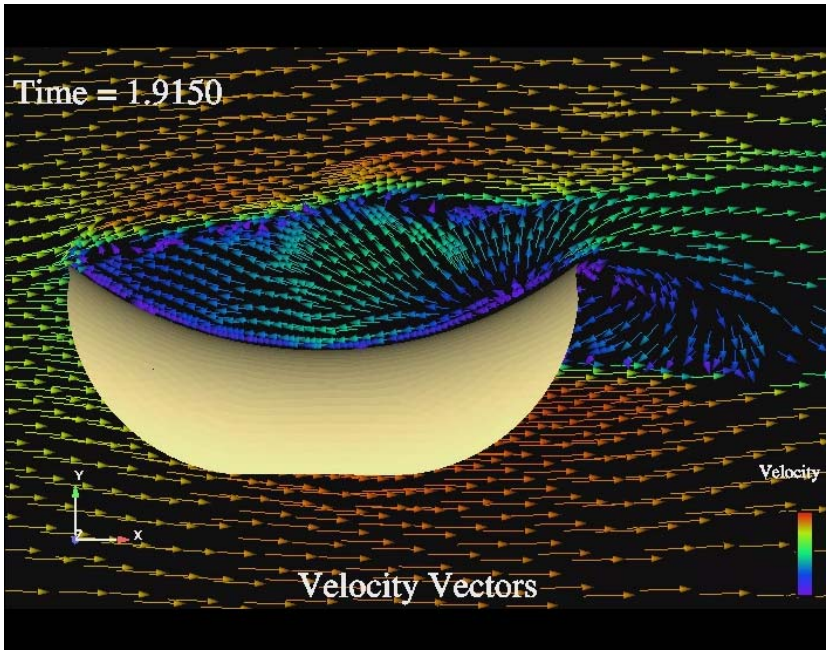
CAE Behind Everyday Products: Innovating How P&G Innovates

Tom Lange of Procter & Gamble will be the featured speaker at CIE 2007 in Las Vegas in September. In his presentation, Tom will answer the question:

"How can modeling & simulation greatly accelerate the pace of innovation? With Procter & Gamble making and selling billions of things every day, we will explore some of the 'surprising' technical challenges this presents, from mixing tanks to Pantene™ bottles, from Braun™ shavers to Pringles. Other multi-scale, multi-physics examples and challenges will be discussed. Computing costs are projecting by 2010 to be 1/100th the cost they were at the start of this decade. What are we going to do with all that power? How are we going to engage more scientists, engineers and designers in



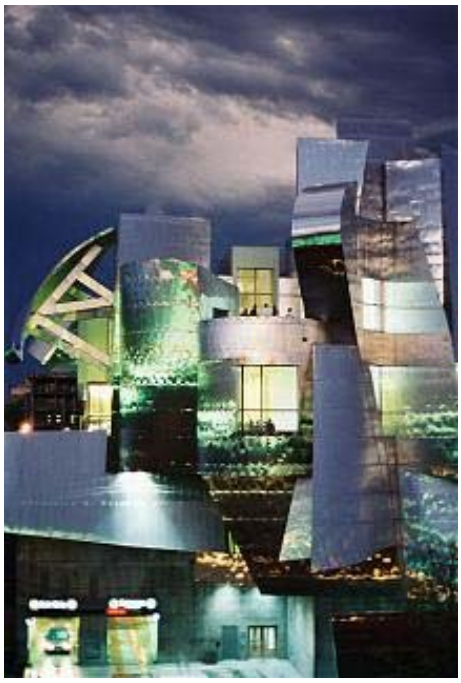
An example of the surprising ways that modeling and simulation pop up in the design of everyday consumer products: the Pringles potato chip in flight.

using CAE in EVERY decision? How are going to manage all the simulation data for the long term? What are the emerging work processes that shape key decisions for the customers of CAE analysis?"

Tom Lange of Procter & Gamble, speaker at the upcoming CIE 2007 Conference in Las Vegas.

CIE History Photo Quiz

Recognize any of these past CIE conference venues? Albuquerque, Irvine, Minneapolis, Long Beach, we've been all over. David Lee has done an excellent job archiving photos over the years, which he has placed on our web site. For flashbacks, see the "CIE's 25th Anniversary" link at divisions.asme.org/cie and look at the photos in our History and Perspective section.



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Join us in Seattle for ASME Congress 2007

November 11-15, 2007
Sheraton Seattle Hotel
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Join the CIE Division and thousands of your colleagues in Seattle, Washington USA for a week of exchanging ideas, networking, and conducting business. At hundreds of technical sessions, special forums, product exhibits, industrial tours and social events, you'll receive updates on current trends, learn new techniques, trade tips and explore the technical worlds of your fellow mechanical engineers while venturing out and around downtown Seattle.

2007-08 CIE Executive Committee

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