Journal of Computing and Information Science in Engineering

Editorial

Special Issue Commemorating the 25th Anniversary of the ASME CIE Division

We are pleased to bring out this special issue of JCISE to provide both a retrospective and a snapshot of key areas in computing and information science as they relate to electro-mechanical product development. We invited some of the leading researchers from areas of current interest to write survey articles about their respective fields. While this issue does not cover all of the areas encompassed by CIE, either from a historical perspective or at the current evolutionary point of the Division, it offers a unique view of what is quintessential to the technical domain of CIE.

Over the past 25 years, computers have revolutionized not only all types of products and services, but also the way engineering products are designed and produced. This has created a societal transformation of a magnitude not seen since the industrial revolution. Twenty-five years ago, visionaries such as Ali Seireg, Irwin Berman, L. Eugene Hulbert, T. James Cokonis, Jim Callahan, Terry Shoup, Vijay Tipnis, Ewald Heer, Don Riley, David Dietrich, Steve Rohde, and Gopal Gupta recognized the potential profound impact of computers on the mechanical engineering profession when they created a new Division at the 100th Anniversary mark for ASME.

The Computer Engineering Division was founded to provide a forum for mechanical engineers and people from related fields to exchange ideas, advance the technology and its applications to their respective problems, and to keep abreast of the latest developments. Over the past 25 years, the division has grown and evolved to become what is now known as the Computers and Information in Engineering (CIE) Division. By hosting an annual conference since its founding, the papers published in the proceedings of the CIE Conferences provide a road map of the development and maturation of computing systems in mechanical engineering.

We have reviewed the proceedings of the CIE Conferences from 1980 up to 2004 in order to identify areas in which the CIE community has been most active. The wide range of research areas and applications published and presented, such as CAD/CAM, robotics, controls, dynamics, thermofluids, FEA, and many others provides an interesting perspective to see how CIE has evolved over the years.

At the first conference in 1980, the papers covered the full spectrum of computing platforms, from calculators to mainframes. While many papers during the early years focused on the numerical results generated from programs written to run on the multiplicity of platforms, a large number of authors brought new technologies to bear on harnessing computational capability for providing new insight into engineering problems. These included the application of graphical interfaces and standards as well as concepts developed in computer and information sciences such as knowledge-based systems and computational geometry.

Coverage of robot off line planning, geometric pattern recognition algorithms and automated methods for finite element generation were a mainstay of work published throughout the 1980s. The first papers on Expert Systems appeared in 1984, followed by enough papers to fill several sessions in the following year. These simplistic expert systems were directed at very specific problems, such as V-belt design, 4-bar linkages, spur gears, etc. Papers on solid modeling appeared in 1984–1985 also, including a paper on a graphical front end to PADL-2.

When solid modeling first became available, many deemed it unusable because of the difficulty of editing models. CIE researchers were at the forefront of technologies that made parametric-based CAD possible, such as associativity and constraint solving, features and part positioning in assemblies. Evidence of this can be found as far back as 1986. Parametric CAD is surveyed by Hoffman in this issue and the challenges faced in developing and using this technology show that there continue to be many unresolved issues in this area.

In the mid and late 1980s, Feature Technology went on to become one of the most popular research areas in CIE; this includes design by features, feature recognition and feature-based applications particularly in manufacturing. The article by Corney, Hayes, Sundarajan and Wright looks specifically at the role of features in integrating CAD and CAM and the broader issues of generalized feature classes, feature interaction and process specific feature relations.

Towards the end of the 1980s and into the 1990s, people became concerned with scalability, robustness and inter-operability. The influence of standards such as IGES, GKS, PHIGS, STEP, PDES, and many others that were begun in this time frame, echo through the debates of the current day of open standards and open source. Also, there was a trend from focusing on specific applications (point solutions) to more domain independent systems, of which DOMINIC is a good example.

In this time period, there was a great deal of activity in data and information issues in engineering. Issues being investigated included PDM (Product Data Management) and data exchange standards for geometry and features. Much of this was motivated by the desire to create concurrent engineering and collaborative design frameworks. Interest in modeling supply chains and LCA (Life Cycle Engineering) began to develop. Two articles in this issue deal with these topics. Rangan, Rhode, Peak, Chada, and Bliznakov give a review of the current state of PLM. Sriram, Fenves, Subrahmaniam and Rachuri discuss a broader vision of product data exchange.

The availability of the Internet to the general public in the mid 1990s, opened up many new possibilities for collaboration, services and information exchange. A part of CIE became focused on Internet-based design and commerce. Also, in the late 1990s, virtual reality and haptics made it possible to create completely new immersive CAD/CAE environments.

Today we find engineers trying to push computers further upstream in the design process, as well as further downstream. Upstream areas include tasks at conceptual design stage. Functional and behavior models are being developed, as well as ontologies. Design synthesis methods are discussed in the survey article by Cagan, Campbell, Finger and Tomiyama. Another area of current

interest is design repositories, methods to store, index, and retrieve design data, including CAD models and design rationale.

There is also on-going research in creating a seamless integration between design and analysis through multi-physics simulation and virtual prototyping. The survey article in this issue by John Michopolous describes this area. Another CAE topic, structural optimization, is reviewed by Saitou, Nishiwaki, Izui, and Papalambros.

Detailed design has evolved from the "over-the-wall" methods to performing DFM (Design for Manufacturing) and tolerance analysis as early as possible. While the number of people working on GD&T is small, many papers on this topic have appeared all through the years of CIE Conferences. Shen, Ameta, Shah and Davidson compare computer aided tolerance analysis methods currently available commercially.

Ever present throughout the 24 years of the Conferences, the CIE community has focused on the effective integration and use of CAD/CAM/CAE in education. Articles in CIE on the use of computers in education began at the first conference in 1980 and have evolved to match the product-centric design methods of today. Rosen, Kinzel and Khosrowjerdi provide a nice survey of how our curriculums have developed over the years.

We thank the authors for their contributions to this special issue and wish to congratulate the CIE Division, its Conferences, as well as ASME as each celebrates its own extra special anniversary in 2005.

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