

Discovering Knowledge in Design and Manufacturing Repositories

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A Position Paper for the IJCAI-01 Workshop on Knowledge Discovery from Distributed, Dynamic, Heterogeneous, Autonomous Data and Knowledge Sources

Extended Abstract

The National Design Repository Project (<http://www.designrepository.org>) is creating a digital library of computer-aided design and manufacturing data. A main objective of this effort is to identify techniques to harvest this data and enable improvements in the engineering process. Presently the Repository consists of over 55,000 CAD and solid models, assemblies—some with related documents, such as cost information or process and assembly plans. For the most part, the data is heterogeneous; where homogeneity exists, it is only in the form of the representa-

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tion of product model data with the ISO STEP AP 203 standard for the description of mechanical assemblies.

Some of the research issues being addressed in this ongoing project include:

- Data mining on CAD/CAE data in order to identify patterns that can be used to drive improved design and manufacturing decisions. We have conducted experiments on that mine Repository data to perform case-based variational design, variational process planning, cost estimation and shape analysis [2, 7, 3, 4, 5].
- Representation of diverse and ill-structured engineering knowledge. The Repository is attempting to capture the design intent and design rationale for electro-mechanical artifacts; as well as their structure, behavior and function. We are currently exploring the use of XML and DAML, the DARPA Agent Markup Language, to formally describe these concepts [14, 10, 13] [8, 12, 11].
- Interactive interfaces for specifying queries to the Repository. Specifically, we have been building a conceptual design environment (MUG) which will allow a group of users, during the early phase of design, specify a high-level functional and structural layout of an artifacts. One planned use for this design concept is as a query to the Design Repository in a search for similar or related design or manufacturing situations. In this way, archived knowledge can be used to assist with variational design [1, 9].
- Capture of design and manufacturing knowledge for indexing in Design Repositories. We have studied how the current generation of computer-supported cooperative work (CSCW) environments can be integrated with current design and manufacturing environments in order to unobtrusively convert design activity into knowledge about design rationale and intent. We are also building agents that can populate our representations through monitoring of design, manufacturing and collaborative work environments [17, 16, 15, 6].

The generation-after-next engineering environment will integrate product design, manufacturing and multi-disciplinary collaboration. This will create unprecedented opportunities to archive engineering activities and leverage them during the lifecycle of products, or in the development of new products. One can envision designers with access to search tools that enable them to examine the

design decisions made earlier and retrieve records of meetings and emails related to specific project decisions. Such repositories will be a fertile ground for developing agents that monitor design and manufacturing planning activity and offer guidance based on past experiences (e.g., cost estimation, manufacturing process selection, etc.).

It is our belief that all of these potential applications will require a novel integration of data mining, learning and knowledge discovery technologies with the dynamic domains of engineering design and manufacturing. For this to occur, we need to develop ideas on how to handle new media types (such as those found in CAD/CAM/CAE and CSCW) and extract relevant knowledge from the heterogeneous mix that will be collected in future engineering repositories.

Acknowledgements. This work is being supported in part by National Science Foundation (NSF) Knowledge and Distributed Intelligence in the Information Age (KDI) Initiative Grant CISE/IIS-9873005; CAREER Award CISE/IIS-9733545 and Grant ENG/DMI-9713718. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation or the other supporting government and corporate organizations.

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