

A Review of Research in Mechanical Engineering Design. Part II: Representations, Analysis, and Design for the Life Cycle

Susan Finger^{1,*} and John R. Dixon²

¹Robotics Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA; ²Department of Mechanical Engineering, University of Massachusetts, Amherst, Massachusetts, USA

Abstract. This is the second of a two-part paper summarizing and reviewing research in mechanical engineering design theory and methodology. Part I included 1) descriptive models; 2) prescriptive models; and 3) computer-based models of design processes. Part II includes: 4) languages, representations, and environments for design; 5) analysis in support of design; and 6) design for manufacture and the life cycle. For each area, we discuss the current topics of research and the state of the art, emphasizing recent significant advances. A final section is included that summarizes the six major areas and lists open research issues.

Introduction

This two-part paper, the first in a series of reviews to be published in *Research in Engineering Design*, summarizes and reviews the state of research in engineering design theory and methodology, concentrating on mechanical engineering design. Subsequent reviews will concentrate on other areas of engineering design or on special sub-topics. The goal of the series is to inform the community at large of advances in the developments in engineering design research. We also hope that it will enable researchers to place their work in context and thus guide continuing work. The series of papers is also intended to be an efficient starting place for those who wish to become familiar with the engineering design literature relevant to their interests.

There are, of necessity, limits to the nature and scope of this review. First, the review is not intended to be a substitute for reading complete papers; it is intended only as a brief summary of, and guide to, the literature. Although we have made every reasonable effort to be complete, omissions are inevitable. There can also be errors of commission caused by misinterpretation or lack of full understanding on our part of papers included in the

review. We apologize to both readers and researchers for these errors.

The scope is limited in several ways. We intend only to include research in engineering design, and then only that portion of engineering design broadly called "mechanical," which includes products, machines, structures, and the like. Research in geometric modeling, architectural design, manufacturing, expert systems, and optimization are included only when the research is directly relevant to design of mechanical systems. We have also not attempted to cover the many new, commercial computer-aided design (CAD) systems which have begun to incorporate the research ideas discussed in this review.

The research discussed in this review paper has been conducted primarily in the United States. Work outside the U.S. has not been excluded, but is not covered systematically. Finally, research on mechanical design in very specific technical domains (e.g., mechanisms and heat exchangers) is not covered unless it is clearly extendible to other mechanical design domains.

This review is organized into six sections based on our current view of the active design theory and methodology research areas. These six areas are:

1. Descriptive models of design processes
2. Prescriptive models for design
3. Computer-based models of design processes
4. Languages, representations, and environments for design
5. Analysis in support design decisions
6. Design for manufacturing and other life cycle issues such as reliability, serviceability, etc.

These six categories are certainly not mutually exclusive, and some research overlaps two or more areas. In such cases, we have done our best to inform readers where research projects have been placed. In Part I, the first three of the above six topics were reviewed. In Part II, we review the last

* Reprint requests: Robotics Institute, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

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web oct 23 2021 1 what particles determine the mass number 2 why is mass number always a whole number 3 one isotope of carbon c has exactly the same mass number and atomic mass sin used as the definition of the atomic mass unit amu which isotope is it and what atomic mass 4 what is the approximate mass of one proton amu 5

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web define isotope using mass number atomic number number of protons neutrons and electrons given information about an element find the mass and name of an isotope give evidence to support or dispute in nature the chance of finding one isotope of an element is the same for all isotopes

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web the atomic mass of a single atom is simply its total mass and is typically expressed in atomic mass units or amu by definition an atom of carbon with six neutrons carbon 12 has an atomic mass of 12 amu other atoms don t generally have round number atomic masses for reasons that are a little beyond the scope of this article

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web jul 29 2021 as you learned the mass number is the sum of the numbers of protons and neutrons present in the nucleus of an atom the mass number is an integer that is approximately equal to the numerical value of the atomic mass although the mass number is unitless it is assigned units called atomic mass units amu because a molecule or a

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web atomic structure google classroom what three particles make up an atom choose 1 answer protons neutrons and photons
a protons neutrons and photons positrons neutrons and electrons b positrons neutrons and electrons protons electrons and
positrons c protons electrons and positrons protons neutrons and electrons d