

Preface

We have all seen street musicians at work playing several instruments simultaneously and admired their ability to sound like an orchestra single handed. These somewhat unusual musicians struggle with many and diverse instruments trying to produce well-orchestrated music that the audience will find pleasing enough to contribute to the artist's bread-and-butter. To succeed, the performing artist must be proficient with many instruments, be able to improvise as he goes along and have an ear for the total effect of his efforts. The practitioner of engineering design might feel a certain kinship with this man. Like the musician, the engineering designer needs to have skills in many technical disciplines, to be able to improvise and to come up with new ideas as problems are encountered. Further, in the same way as the music, the product that comes out of the design process will be judged in its entirety, not by the properties of its individual parts.

Is it meaningful, or even possible, to use computers for unstructured, multidisciplinary and creative tasks such as engineering design? This book seeks to give a qualified answer to this question. It will be apparent that the simple question has a complex answer.

There are many tasks in engineering where computers have established a significant role often concerned with product documentation or analysis. This book however is directed towards the use of computers for the purpose of creation. It focuses on how to simulate the work of a design group by implementing engineering knowledge in a computer and then letting the computer operate on this knowledge to produce new design solutions. This is not the kind of creative tasks we normally expect computers to be able to perform and it might appear as if the computer possessed some kind of intelligent behaviour, a kind of Artificial Intelligence. The resemblance to human intelligence is however superficial, but the technology has proved its worth on many types of design tasks. We call this technology Automated Engineering Design or Design Automation, DA. The focus is on the synthesis tasks of design work rather than the analysis tasks, which are normally aimed at predicting the behaviour and properties of a given design proposal.

In this book, the term Automated Engineering Design is used in the straightforward meaning of partly or completely automating tasks in the engineering design process by the use of computer support. Such tasks are mainly found within a category of what is called “variant design” or “redesign” in a broad sense. This implies that the intended design process is well understood and does not require any innovations or new knowledge—the computerised design system will always operate “inside the box”.

Designing new products is a different matter. This will always require elements of creativity, resourcefulness and subjective judgment. Good, original design must exhibit a “spark of life” to be successful on the market. This, in the opinion of the author, is something a computer will never be able to deliver. Admittedly though, past prophecies of the future of the digital computer have in retrospect tended to underestimate its potential.

This book aims to discuss how to plan and build useful, reliable, maintainable and cost-efficient computer systems for automated engineering design. The book takes a user's perspective and seeks to bridge the gap between texts on principles of computer science and the user manuals for commercial design automation software. The approach taken is top-down, following the path from definition of the design task and clarification of the relevant design knowledge to the development of an operational system well adapted for its purpose.

This is an introductory text for the practicing engineer working in industry and covers most vital aspects of planning such a system. Experiences from applications of automated design systems in practice are reviewed based on a large number of real, industrial cases. The principles behind the most popular methods in design automation are presented with sufficient rigour to give the user confidence in applying them on real industrial problems. The textbook is also suited for a half semester course at graduate level and has been complemented by suggestions for student assignments. The primary purpose of the book is to discuss application of design automation methods, but the reader will find that the study of design automation will also shed new light on the manual design process as is often the case when computer technology is applied to a familiar task.

The perspective is that of the specialist of the field of application rather than the specialist in computer science. For the latter, who has an interest in seeing his/her subject from a user perspective, the book will offer new insights. The examples are taken from the field of mechanical engineering, but the book should be equally applicable to, e.g. civil engineering or electrical engineering. The book has grown out of the lecture notes of two postgraduate courses given annually or biannually during the last ten years at the product development program at the School of Engineering at Jönköping University.

Some time ago, a young relative of mine asked me what my research work was all about. I said that I worked with computer support for variant design and explained in a few words what this meant. She replied: “But Staffan, this sounds incredibly boring, how can you stand working with such things?” I was somewhat taken aback by this reaction since I have always found my work exciting and

thought-provoking. Obviously I had not succeeded in communicating my enthusiasm for the subject. When writing this book, I have tried to keep this conversation in mind in order to not only cover the utilitarian aspects of the subject but also emphasise its much wider implications and the insights it gives into designing and planning and, maybe, into human thinking in general.

Jönköping, Sweden

Staffan Sunnersjö

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