

Preface

Unless you are Homer, the sensible course to take in any narrative, whether it be fiction or somewhat factual, is to start at the beginning, proceed through the middle and finish at the end. This book is not like that. CAD is something of a Gordian knot in which it is difficult to find an end from which to start. The purpose of the book is not to criticise, but to explain how CAD systems work, relate this to theoretical aspects, explain shortcomings and limitations. The book is not supposed to be about any one particular system, though some are mentioned. Many CAD systems have similar functionality and, wherever possible, this functionality will be explained rather than particular implementations. This is because CAD systems are dynamic and, hopefully, will continue to change as new requirements and ideas appear. The techniques behind, though, are more stable and, in order to understand what a CAD system is doing, it is helpful to understand what is going on behind the interface.

CAD systems are a combination of knowledge from, at least, the three domains: computer science, mathematics and engineering. They are complicated and hence it is difficult to be an expert in all three domains. For this reason it is common that software experts implement the software rather than the engineers for whom the systems are intended. This means that there can be differences between the way that a system works and what the user would expect.

The intended audience of this book is:

- CAD users—Both students and professional users who would like to understand more about the CAD tool that they are using. The examples and exercises are intended to give an insight into what is going on behind the functions so that it is easier to avoid problems, but also to understand those problems which do occur.
- CAD teachers—People who would like to teach CAD at a higher level than just which buttons to push to get a result. The exercises and examples in the book are intended as a supplement to normal teaching with example exercises.
- CAD system developers—The book tries to present some of the ‘other side’ of CAD, a little of where the current system philosophy is wrong or where it could be improved.

The way this book is organised is that the first chapter is intended to demonstrate some simple object creation sequences and to pose some of the questions that a user might put. These questions are a sort of introduction to the material in some of the other chapters.

[Chapter 2](#) explains some of the history, about different solid modelling methods, before describing Boundary Representation (B-rep), the current main method, in more detail. CAD systems worked with wire-frame modelling and then constructive solid geometry (CSG) methods before settling for B-rep.

[Chapter 3](#) describes two-dimensional definition methods and [Chap. 4](#) describes the main model creation operations that are used to create models. Along with the operations are brief descriptions of algorithms and special cases. There are suggestions for various experiments to illustrate some limitations and explain what is happening. [Chapter 5](#) describes, briefly, another important area, the geometry of parts. [Chapter 6](#) defines non-manifold models and examples of their use in a hybrid modelling environment. [Chapter 7](#) describes graphics input and output in CAD. Together this group of chapters describes the core modelling functions of CAD systems.

The next chapter, [Chap. 8](#), describes information in models. This can be thought of as an add-on to the basic model for improving the level of communication between application areas. [Chapter 9](#) describes current methods for exchanging model data.

[Chapter 10](#) describes some aspects of the complex topic of features. This is a rather subjective topic and there is a wide variety of perception about what constitutes a feature. The chapter presents some of the history and some of the uses of features.

[Chapter 11](#) presents some of the gaps in CAD. In general CAD systems are often used as modelling systems to create detailed geometric models of products whereas a lot of design precedes this phase. The chapter presents a little research work in this area as an illustration of how CAD systems might (and should) develop to provide a uniform design environment.

[Chapter 12](#) presents some aspects of command files and their modern use as history records in CAD is presented. The chapter also describes aspects of object parametrisation. Often, products are collections of single models connected in some way. [Chapter 13](#) concerns the way that these collections, or assemblies, are built up and connected. [Chapter 14](#) describes different aspects of CAD in communities. This concerns how to work with other people in CAD as well as analysis methods to aid the designer communicate with other partners in the production chain. Finally, [Chap. 15](#) outlines some possible projects. These projects were used in teaching at the EPFL to reinforce different aspects of CAD.

Good luck.

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Solid Modelling and CAD Systems

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