

The background of the book cover is a dark, monochromatic image. It features a large, semi-transparent gear shape in the center. Inside and around the gear, there are faint, light-colored images of industrial machinery, including what appears to be a CNC machine with a tool head and various mechanical components.

# An Introduction to **CNC** **Machining** and **Pro-** **gramming**

David Gibbs and  
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An Introduction To  
**CNC Machining  
and  
Programming**

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## DEDICATION

I would like to dedicate my work on this textbook in loving memory of my grandfather, Edgar L. Crandell. I also dedicate my work to my parents Gale and Beverly Crandell. It was these three individuals who taught me to work hard to complete a task and to do it to the best of my ability. I thank them for their time and patience during my upbringing.

My thanks goes to the following: My family—Linda, Chad, and Todd—for time spent away from them; Ferris-State University for equipment support; and Ferris Faculty and Staff that provided assistance.

Thomas M. Crandell

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## PREFACE

*An Introduction to CNC Machining and Programming* is the essentially practical activity of preparing computer numerical control (CNC) part programs for turning, milling, and drilling. It has value to students in a wide range of courses, from introductory and calculations of all forms, tooling for CNC programming in a major or related course in a college, university, or technical school.

The preparation and proving of CNC part programs requires machinery and computer installations in order to gain the necessary experience. Using such equipment, and understanding the languages and techniques, requires instruction by a competent instructor. Students undertaking CNC programming will therefore find it necessary to attend a college or training center. The student must have a good knowledge of basic machining techniques, and should ideally be familiar with turning, milling, and drilling operations. In addition, the mental requirements have been borne in mind.

CNC part programming is an absorbing and challenging one of the few areas of study where students can learn too quickly! Thus a primary objective of this text is that course time can be used to the best advantage by devoting as much time as possible to preparing and proving part programs. Accordingly, an attempt has been made to provide the student with much of the information to support the more practical elements of study, rather than on formal lectures and unnecessary note taking. The student with the opportunity to study specifically is encouraged.

This text is essentially practical in nature and is intended as material for course work. It contains a series of exercises for the student with a practical understanding of CNC programming by various means. Throughout the text, detailed drawings of components in inch and metric are included to complement the text, may also be used in the early stages of a course. An additional series of drawings of degrees of complexity and intended for later study are included for ability.

It is the author's experience that many readers will find



## PREFACE

for retraining, also many younger students, are hampered in their programming work by never being taught how to apply their calculation skills in algebra, geometry, and trigonometry. It is generally outside the scope of a course of study devoted to part programming to spend much time rectifying this state of affairs, and yet it cannot be ignored. To assist both instructors and students there is a chapter devoted entirely to the type of calculations that will be encountered when preparing part programs manually; it is hoped that the completion of this material, supported by on-the-spot tutoring by faculty, will be of value.

This text will be of on going value to students, faculty, and industrial programmers alike.

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Workingham

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# 1

## AN INTRODUCTION TO OF COMPUTER NUMERICAL

### DEFINITION OF NUMERICAL

*Numerical control (NC)* is the term used to movements and various other functions by ins numbers and initiated via an electronic control

*Computerized numerical control (CNC)* is a system utilizes an internal computer. The inte following: storage of additional programs, progr from memory, machine and control diagnos metric-incremental/absolute switchability.

The two systems are shown diagrammatical may be free-standing or built into the main s erating panel of an integrated control unit is

### THE APPLICATION OF COMPUTER

Computer numerical control is applied to a v cesses such as metal cutting, woodworking, w forming, sheet metal punching, water jet cutt ing and laser cutting. The text that follows common machine-shop engineering processes drilling, where it has been particularly succe

### THE ADVANTAGES OF COMPUTER

Computer numerical control is economical for single-item production. Many factors contrib most important of these being as follows:

- (a) high productivity rates
- (b) uniformity of the product
- (c) reduced component rejection

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