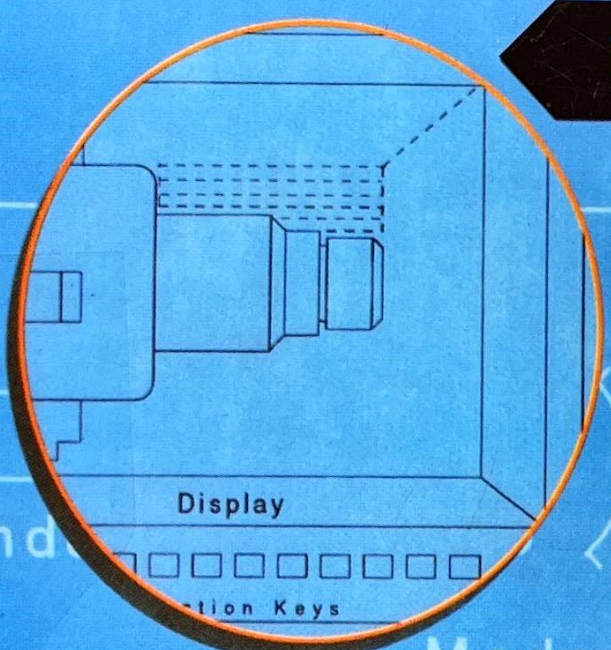
Eastern Economy Edition

Computer Numerical Control

Operation and Programming

Third Edition



Jon Stenerson Kelly Curran

CDs INCLUDED

COMPUTER NUMERICAL CONTROL

OPERATION AND PROGRAMMING

THIRD EDITION

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FOX VALLEY TECHNICAL COLLEGE

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Contents

Preface vii

Acknowledgments x

Section I G-Code Programming

Chapter 1: Introduction to Computer Numerical Control 1

Chapter 2: Basic Trigonometry 29

Chapter 3: Carbide Fundamentals 41

Chapter 4: Fundamentals of Programming 61

Chapter 5: Programming Examples 97

Chapter 6: Work Holding and Tooling for Machining Centers 121

Chapter 7: Fundamentals of Machining Centers 141

Chapter 8: Programming Machining Centers 159

Chapter 9: CNC Turning Machines 183

Chapter 10: Programming CNC Turning Machines 211

Chapter 11: Electrical Discharge Machining (EDM) 247

Chapter 12: Abrasive Waterjet and Laser Cutting 271

Chapter 13: Fundamentals of CAD/CAM 291

Section II Conversational Programming

Chapter 14: Introduction to Mazatrol Programming 301

Chapter 15: Introduction to Fanuc FAPT Programming 363

Section III Quality

Chapter 16: Fundamentals of Statistical Process Control 429

Chapter 17: Statistical Process Control 447

Chapter 18: Introduction to ISO 9000 469

Appendix A: Instructions for Installing and Using Predator Software 481

Appendix B: Programming Codes for Major Machine Controls 489

Glossary 495

Index 507

Preface

We decided to write the first edition when we were unable to find a practical, easy-to-understand book with enough examples and programming assignments. In the third edition, we have made major changes in the programming chapters. We added many additional questions and exercises to chapters to guide readers who are learning how to program. We also added a chapter on abrasive waterjet and laser machining. Abrasive waterjet and lasers are dramatically changing the machining industry. There are many other differences that we hope you will appreciate as you use the book. The questions and exercises lead the reader through a step-by-step process to learn to write CNC code.

We are very excited about the inclusion of Predator Software, Predator Editor™, and Predator Virtual CNC™. This software will enable the reader to write and simulate programs in 3D on a computer. We have included the programs in the book on the CD so the reader can watch them run.

The information in this textbook is based on our years of experience teaching CNC courses to students at Fox Valley Technical College in Appleton, Wisconsin, as well as industrial CNC courses for local business and industry, university and technical school students, and on-the-job trainees. We sincerely hope that our logical, easy-to-understand approach will enable readers to accomplish more than would otherwise be possible.

The third edition is organized into three sections: G-Code Programming, Conversational Programming, and Quality.

SECTION I: G-CODE PROGRAMMING

Chapter 1 is an introduction to computer numerical control. It examines the history of CNC, types of CNC machines, components of CNC machines, the Cartesian coordinate system, and absolute and incremental positioning. It provides the foundation for CNC programming.

Chapter 2 is an easy-to-understand chapter on trigonometry. It provides the reader with a practical approach to using trigonometry to calculate missing information on blueprints so that programs can be written.

Chapter 3 covers carbide cutting technology. Machinists need a good understanding of the proper use of carbide tooling to be productive. They need to understand available tooling technology and the speeds and feeds required to make carbide efficient. The chapter also covers tool geometry and selection.

Chapter 4 covers the fundamentals of programming. This chapter has been improved through a more step-by-step approach to programming and extensive questions and exercises that lead the reader through simple examples to understand basic programming and develop simple CNC code.

Chapter 5 is a completely new chapter. It builds upon what the reader learned in Chapter 4 through the use of CNC program examples. Each of the programs are thoroughly explained in line-by-line fashion to lead the reader through all of the important aspects of programming.

Chapter 6 is a new chapter that examines work holding for machining centers. It also covers proper setup procedures and tooling for machining centers.

Chapter 7 covers the fundamentals of machining centers. It covers types, components, tooling, and operation of machining centers.

Chapter 8 covers programming machining centers. This chapter builds upon the previous programming chapters and adds material on the use of canned cycles to ease program development.

Chapter 9 covers the fundamentals of CNC turning centers. Types of CNC turning centers, components of a typical turning center, axes of motion, work holding, tooling, and operation are covered.

Chapter 10 examines programming CNC turning centers. Material has been added and modified to make it easier to understand tool and work offsets. The chapter leads the reader through examples to illustrate the use of all common turning codes and canned cycles.

Chapter 11 covers Electrical Discharge Machining (EDM). This topic is missing in most CNC texts. This chapter explains the technology and components and then leads the reader through programming examples.

Chapter 12 is a new chapter on abrasive waterjet and laser cutting. These technologies are dramatically changing the way industry makes parts. They can be used to make premachined part blanks to reduce machining time. They can also completely eliminate further machining in many cases because of their ability to produce good surface finishes and hold tight tolerances. Shops that do not currently have these technologies should be examining them for their ability to dramatically increase productivity.

Chapter 13 is a basic introduction to the fundamentals of CAD/CAM. It is intended to give the reader a fundamental understanding of how CAD and CAM can be used and integrated to provide the information needed for CNC part programs.

SECTION II: CONVERSATIONAL PROGRAMMING

Chapter 14 covers programming a Mazak machining center in conversational programming. It leads the reader through step-by-step programming of Mazak conversational language.

Chapter 15 covers programming a Fanuc turning center in conversational programming. It leads the reader through step-by-step programming of Fanuc conversational language.

SECTION III: QUALITY

Chapter 16 examines the fundamentals of statistical process control. This chapter will help the reader understand the importance of statistics in process control and improvement. Quality improvement is vital if companies are to compete in a world economy.

Chapter 17 leads the reader through the development and use of process control charts. These can be used to ensure that processes are running optimally. They can also be used to indicate when a process goes out of statistical control. The use of statistics and charts can dramatically reduce part variation and improve quality while, at the same time, reducing the cost of quality.

Chapter 18 examines ISO 9000 quality systems. This chapter has been rewritten to reflect the new standard. Employees need to have a good understanding of the standard and its intent to appreciate the benefits that can come from a good quality business system.

Appendix A provides a tutorial in Predator software, and Appendix B contains programming codes for major machine controls.

CDs INCLUDED WITH THIS TEXT

One CD contains programming tutorials for the Okuma machining center, Okuma turning center, Milltronics mill, and Bridgeport EZ-Path lathe, as well as sample chapter programs.

The other CD contains a student version of Predator Editor™ and Predator Virtual CNC™ that the reader can use to write and test programs. Predator Editor™ and Predator Virtual CNC™ are included with this text with permission of Predator Software, Inc., copyright 1994–2005.

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