

# Contents

- 1 Introduction . . . . . 1**
  - 1.1 Historical Background . . . . . 1
  - 1.2 Motivation of Dynamic Thermal Analysis . . . . . 5
  - 1.3 Organisation of the Book . . . . . 7
  - References . . . . . 8
- 2 Data Representation of Machine Models. . . . . 11**
  - 2.1 Introduction . . . . . 11
  - 2.2 Classification of Solid Modelling Methods . . . . . 12
  - 2.3 Representation of Machine Tool Models . . . . . 16
    - 2.3.1 Geometric Representation . . . . . 17
    - 2.3.2 Topological Representation . . . . . 19
    - 2.3.3 Construction of Shapes . . . . . 20
  - 2.4 Establishment of a Primitive Library . . . . . 22
    - 2.4.1 Data Structure . . . . . 22
    - 2.4.2 Definitions of Primitives . . . . . 24
  - 2.5 Concluding Remarks . . . . . 28
  - References . . . . . 29
- 3 A Modelling System for Machine Tool Design. . . . . 31**
  - 3.1 Introduction . . . . . 31
  - 3.2 Design Process of Machine Tools . . . . . 32
    - 3.2.1 General Specification . . . . . 32
    - 3.2.2 Design Methodology . . . . . 37
    - 3.2.3 Design Process . . . . . 39
  - 3.3 Requirements of a Product Modelling System. . . . . 42
    - 3.3.1 Product Models. . . . . 42
    - 3.3.2 Requirements . . . . . 43
  - 3.4 Development of Product Modelling System . . . . . 45
    - 3.4.1 Structural Configurations of Machine Tools . . . . . 45
    - 3.4.2 Modelling of Part Information . . . . . 47

3.4.3	Modelling of Structural Information . . . . .	50
3.4.4	Kinematic Simulation . . . . .	53
3.5	Case Studies . . . . .	53
3.6	Concluding Remarks . . . . .	55
	References . . . . .	57
<b>4</b>	<b>Dynamic FEM Mesh Generation . . . . .</b>	<b>59</b>
4.1	Introduction . . . . .	59
4.2	Classification of Mesh Generation Methods . . . . .	62
4.3	Concept of Dynamic Mesh Generation. . . . .	66
4.3.1	General Considerations . . . . .	66
4.3.2	Basic Procedures. . . . .	67
4.4	CBC Substitution. . . . .	69
4.4.1	Procedures for CBC Substitution. . . . .	70
4.4.2	Determination of $N$ -Labels. . . . .	73
4.4.3	Determination of $F$ -Label. . . . .	77
4.4.4	Selection of Suitable CBCs . . . . .	79
4.5	Extension of CBC Substitution . . . . .	79
4.5.1	Concept of Two-Space Meshing . . . . .	79
4.5.2	Mapping and Inverse Mapping . . . . .	80
4.5.3	Algorithm of Extended CBC Substitution . . . . .	82
4.6	Application of CBC Substitution to Machine Tool Models. . . . .	85
4.6.1	Considerations of a New Data Structure . . . . .	85
4.6.2	Representation of Machine Tool Models . . . . .	85
4.6.3	Utilisation of Machine Tool Model in Meshing . . . . .	87
4.7	Case Studies . . . . .	88
4.8	Concluding Remarks . . . . .	90
	References . . . . .	92
<b>5</b>	<b>Dynamic Thermal Analysis. . . . .</b>	<b>97</b>
5.1	Introduction . . . . .	97
5.2	Formulation of Thermal Analysis . . . . .	98
5.2.1	General Considerations . . . . .	98
5.2.2	Formulation . . . . .	100
5.3	Temperature Distribution Analysis. . . . .	105
5.3.1	Model and Conditions . . . . .	105
5.3.2	Shape Functions of Isoparametric Elements . . . . .	106
5.3.3	Finite Element Calculation. . . . .	109
5.3.4	Interpolation for Continuous Calculation . . . . .	111

Contents	xi
5.4 A Case Study . . . . .	114
5.5 Discussions . . . . .	117
5.6 Concluding Remarks . . . . .	119
References . . . . .	120
<b>6 Conclusions . . . . .</b>	<b>123</b>
<b>About the Author . . . . .</b>	<b>127</b>

Dynamic Thermal Analysis of Machines in Running State

Wang, L.

2014, XV, 128 p., Hardcover

ISBN: 978-1-4471-5272-9