

Contents

Part I Vibration

1 Case Study 1.1: Identification and Active Damping of Critical Workpiece Vibrations in Milling of Thin Walled Workpieces	3
Hans-Christian Möhring, Petra Wiederkehr, Christoph Lerez, Tobias Siebrecht and Holger Schmitz	
1.1 Introduction of the Case Study	4
1.2 Stability of Impeller Blade Machining Operations	6
1.3 Single Degree of Freedom Test Rig	9
1.4 Simulation of the Influence of a Counter Excitation	11
1.5 Preliminary Prototype of Rotational Intelligent Chuck	13
1.6 Sensor Integrated CFRP Structures	15
1.7 Experimental Results	18
1.8 Summary and Conclusion	22
References	22
2 Case Study 1.2: Turning of Low Pressure Turbine Casing	25
Oscar Gonzalo, Jose Mari Seara, Eneko Olabarrieta, Mikel Esparta, Iker Zamakona, Manu Gomez-Korraletxe and José Alberto de Dios	
2.1 Introduction of the Case Study	26
2.2 Analysis of the Fixture and Workpiece.	27
2.3 Fixture Development	29
2.4 Verification and Validation Tests	33
2.4.1 Verification tests	33
2.4.2 Validation tests	36
2.5 Summary and Conclusion	37
References	38

3	Case Study 1.3: Auto-adaptive Vibrations and Instabilities Suppression in General Milling Operations.	39
	Lorenzo Salles, Jason Tsahalidis, Niccolò Grossi, Antonio Scippa, Gianni Campatelli and Harry Tsahalidis	
3.1	Introduction of the Case Study	40
3.2	Active Fixture Development	41
3.2.1	Fixture Architecture and Mechanical Design	41
3.2.2	Actuators Selection and Implementation	43
3.3	Control Logic Development/Implementation.	45
3.3.1	Frequency Analysis and Excitation	46
3.3.2	ANN Model and Simulation	47
3.3.3	GA Controller	47
3.3.4	Synthesis	49
3.4	Validation Results.	49
3.4.1	Equipment and Test-Case	49
3.4.2	Tests Description and Performance Assessment.	50
3.4.3	Results.	51
3.5	Summary and Conclusion.	53
	References.	54

Part II Deformation

4	Case Study 2.1: Detection and Compensation of Workpiece Distortions During Machining of Slender and Thin-Walled Aerospace Parts.	59
	Hans-Christian Möhring, Petra Wiederkehr, Mathias Leopold, Rouven Hense and Florian Hannesen	
4.1	Introduction of the Case Study	60
4.2	Principle Approach	61
4.3	Fixture Frame Test Rigs	62
4.4	Sensor and Actuator Integration Concept	67
4.5	Adaption of NC-Milling Paths	70
4.6	Prototype of the Intelligent Fixture.	72
4.7	Process-Simulation Integrated Machining Operations	74
4.8	Process Simulation of the Final Prototype	75
4.9	Summary and Conclusion.	77
	References.	78
5	Case Study 2.2: Clamping of Thin-Walled Curved Workpieces. . .	81
	Petr Kolar, Jiri Sveda and Jan Koubek	
5.1	Introduction of the Case Study	82
5.2	Demonstration Workpiece.	83
5.3	Introduction of the Fixture Unit	85
5.4	Thickness Sensor	89

5.5	Operator Software.	90
5.6	Communication Concept and Complete Fixture System Description	90
5.7	Tool Selection and Cutting Condition Optimization	91
5.8	Overall Machining Strategy	94
5.9	Case Study Results	96
5.10	Case Study Summary	97
5.11	Conclusions	98
	References.	98
6	Case Study 2.3: Distortions in Aeronautical Structural Parts	99
	Iñigo Llanos, Arkaitz Beristain, Jose Luis Lanzagorta and Hendric Matzat	
6.1	Introduction of the Case Study	100
6.2	First Fixture Design	102
6.2.1	Conceptual Requirements for Fixture 1	102
6.2.2	Requirement Realization for Fixture 1.	103
6.3	Second Fixture Design	108
6.3.1	Conceptual Requirements for Fixture 2	108
6.3.2	Requirement Realization for Fixture 2.	108
6.4	Results	109
6.4.1	Evaluation of the Stock Residual Stress Characterization and Part Distortion Modules	109
6.4.2	Application of the Developed Methodology to the Test Part	111
6.5	Summary and Conclusion	113
	References.	114
7	Case Study 2.4: Machining of Aircraft Turbine Support Structures	117
	Oscar Gonzalo, Jose Mari Seara, Enrique Guruceta, Mikel Esparta, Iker Zamakona, Nicolas Uterga, Axier Aranburu and Johannes Thoelen	
7.1	Introduction of the Case Study	118
7.2	Fixture Development	120
7.3	Verification and Validation Tests	125
7.3.1	Verification tests	125
7.3.2	Validation tests	127
7.4	Summary and Conclusion	131

Part III Positioning

8	Case Study 3.1: Fixture System for Workpiece Adjustment and Clamping with/without its Pre-deformation	135
	Jiri Sveda, Petr Kolar, Jan Koubek and Jose de Dios	
8.1	Introduction of the Case Study	136
8.2	Developed Solution Overview	137
8.3	Fixture Design	139
8.3.1	Static Fixture—Leveling Unit	139
8.3.2	Static Fixture—Clamping Unit	140
8.3.3	Dynamic Fixture	141
8.3.4	Static Fixture for Clamping with Pre-deformation	142
8.4	System Integration	143
8.5	Validation under Real Conditions	146
8.6	Summary and Conclusion	149
	Reference	149
9	Case Study 3.2: Semiautomatic Tool Reference for Application on Large Parts	151
	Jose Zendoia, Harkaitz Urreta, Alberto Mendikute and Ibai Leizea	
9.1	Introduction of the Case Study	152
9.2	Photogrammetry System	155
9.2.1	Software for Minimisation of Material to be Removed	156
9.2.2	On-machine Photogrammetric Process for Measurement of the Misalignment between the Part and the Machine Axes	156
9.3	3-DoF Alignment Table Design and Fabrication	158
9.4	3-DoF Alignment Table Control	161
9.5	Verification and Validation	161
9.6	Summary and Conclusion	164
	References	165
10	Case Study 3.3: Active Fixtures for High Precision Positioning of Large Parts for the Windmill Sector	167
	Alex Estévez, Germán Rodríguez and Kepa Ayesta	
10.1	Introduction of the Case Study	168
10.2	Clamping Technologies	168
10.3	General Overview of Requirements for Active Fixture Design Approach	169
10.4	Detailed Description of the Proposed Fixturing Solution	171
10.4.1	Clamping Technology	171
10.4.2	Designed Lateral Linear Feed-Drive	172
10.4.3	Design of the Fixturing	173
10.4.4	Control of the Centering Process	174

10.4.5 Intelligent Fixturing	175
10.5 Experimental Validation	177
10.6 Conclusions	179
References.	180
Summary and Conclusions.	181
Author Index.	183

Intelligent Fixtures for the Manufacturing of Low Rigidity
Components

Möhring, H.-C.; Wiederkehr, P.; Gonzalo, O.; Kolar, P.

2018, XXX, 183 p. 171 illus., 166 illus. in color.,

Hardcover

ISBN: 978-3-319-45290-6