List of Figures

Figure	*Title*	*page*
1.1	Deflection of Thin-walled Component during End Milling	1
1.2	Comparison of *GD&T* and *CD&T*	2
2.1	Sources of Error in Milling	7
2.2	Schematic of Mechanistic Force Model [Kline and DeVor, 1983]	9
2.3	Various FE Models of the Thin-walled Component	14
2.4	Geometric tolerance estimation without process faults.	18
2.5	Approaches for Assessment of Cutting Force Models	22
2.6	Determination of Cutting Constant Relationship	23
2.7	Estimation of Distorted Machined Surface	23
2.8	Physics-based framework for geometric tolerance estimation	24
2.9	Comparison of Compensation and Control Strategies	25
3.1	Schematic Illustration of Cutting Edges and Process Geometry Parameters in End Milling	27
3.2	Illustration for End Milling of Different Geometries	29
3.3	Flowchart showing Comparison of Different Analytical Approaches	32
3.4	Flowchart for Calibration of Cutting Constant using Machine Learning	35
3.5	Experimental Setup	36
3.6	Average Cutting Constants (Approach 1)	37
3.7	Flank Edge Cutting Constants (Approach 2)	38
3.8	Bottom Edge Cutting Constants (Approach 3)	38
3.9	ANN Model - (a) Performance Plot and (b) Regression Plot	39
3.10	Comparison of Measured and Predicted Forces (Test 1)	40
3.11	Comparison of Measured and Predicted Forces (Test 2)	40
3.12	Comparison of Measured and Predicted Forces (Test 3)	41
3.13	Comparison of Measured and Predicted Forces (Test 4)	41
3.14	Comparison of Measured and Predicted Forces (Test 5)	42
3.15	Comparison of Measured and Predicted Forces (Test 6)	42
3.16	Comparison of Predicted Forces from Analytical and Machine Learning Model (Test 1)	43
3.17	Comparison of Predicted Forces from Analytical and Machine Learning Model (Test 3)	44
3.18	Comparison of Predicted Forces from Analytical and Machine Learning Model (Test 6)	44
4.1	Tool-workpiece Transition Area and Boundary Conditions	48
4.2	Schematic Illustration of Tool Deflection Model	49
4.3	Schematic Illustration of Workpiece Deflection Model	51
4.4	FE Analysis of Thin-walled Components with the Progress of Material Removal	52
4.5	Variation of Corrected *RDOC*	52
4.6	Overall Framework for Estimation of Distorted Coordinates	53
4.7	Illustration of Geometric Tolerance Parameters for Straight Components	55
4.8	Illustration of Geometric Tolerance Parameters for Circular Components	56
4.9	Algorithm for Estimation of Geometric Tolerance using PSO	58
4.10	Experimental Setup	60

4.11 Comparison of Geometric Tolerance Variation for Straight and Circular Geometries Test 2 - RDOC = 1.5 mm; ADOC = 11 mm 61
4.12 Comparison of Geometric Tolerance Variation for Straight and Circular Geometries Test 6 - RDOC = 4 mm; ADOC = 11 mm 62
4.13 Effect of Component Geometry on Geometric Tolerances Test 3 - RDOC = 1.5mm; ADOC = 18 mm 63
4.14 Illustration of Constant Engagement for Geometries at *"Equivalent RDOC"* 64
4.15 Analysis of Constant Engagement Area on Geometric Tolerances Test 7 - ADOC = 18 mm 65
4.16 Effect of Varying Workpiece Curvature for Concave Geometries Test 7 - RDOC = 4 mm; ADOC = 18 mm 66
4.17 Effect of Varying Workpiece Curvature for Convex Geometries Test 7 - RDOC = 4 mm; ADOC = 18 mm 66
4.18 Effect of Workpiece Rigidity on Geometric Tolerance Test 4 - RDOC = 1.5 mm; ADOC= 25 mm 67
4.19 Effect of Workpiece Rigidity on Geometric Tolerance Test 8 - RDOC = 4 mm; ADOC= 25 mm 67

5.1 Illustration showing Size of Mating Envelope 70
5.2 Illustration showing Orientation of Bounding Feature 71
5.3 Illustration showing Position of Reference Feature 72
5.4 Machined Configuration of the Workpiece 73
5.5 Representative Workpiece Models corresponding to Particles 74
5.6 Computational Framework for Rigidity Regulation Approach (RRA) 75
5.7 Comparison of Rigidity Regulation Approach and Constant *RDOC* Approach 77
5.8 Machining and Inspection of Components after Finishing Pass 77
5.9 Semi-finished Configuration of Straight Component 78
5.10 Axial Surface Error Variation along Length of Component for Straight Component 79
5.11 Flatness Profile and associated Parameters for Straight Component 79
5.12 Semi-finished Configuration of Circular Concave Component 80
5.13 Axial Surface Error Variation along Length of Component for Circular Concave Component 81
5.14 Cylindricity Profile and associated Parameters for Circular Concave Component 81
5.15 Semi-finished Configuration of Circular Convex Component 83
5.16 Axial Surface Error Variation along Length of Component for Circular Convex Component 83
5.17 Cylindricity Profile and associated Parameters for Circular Convex Component 84