Contents

Contents 1

Abstract 3

Zusammenfassung 5

1 Introduction 7

2 Related Work 11
2.1 Surface modeling . . . 11
2.1.1 Simplicial surfaces . . . 11
2.1.2 Parametric surfaces . . . 12
2.1.3 Implicit surfaces . . . 15
2.2 Approximation of functions on manifolds . . . 16

3 The Ambient B-Spline Method 17
3.1 Basic concept . . . 17
3.2 Approximation power . . . 20

4 Realization of the Ambient B-Spline Method 25
4.1 Preliminaries . . . 25
4.1.1 B-splines . . . 25
4.1.2 Dual functionals and quasi-interpolants . . . 28
4.2 Implementation . . . 30
4.3 Examples . . . 38
4.3.1 Geoid . . . 39
4.3.2 Stanford Bunny . . . 43
4.3.3 Cow model . . . 49

5 Hierarchical Approximation 53
5.1 Hierarchical grids and B-splines . . . 53
5.2 Approximation by hierarchical overlays . . . 54

5.3 Approximation by linearly independent hierarchical B-splines 56
5.3.1 Hierarchical quasi-interpolant 67
5.3.2 Stability 70
5.3.3 Implementation aspects of hierarchical B-splines 72

6 Revised Examples Using Adaptive Refinement 75
6.1 Geoid 75
6.2 Stanford Bunny 80
6.3 Cow model 80

7 Curvature Analysis 87
7.1 Introduction 87
7.2 The generalized curvature tensor 88
7.3 Three different setups 90
7.3.1 Parametrized surfaces 90
7.3.2 Implicit surfaces 93
7.3.3 Space deformation 95
7.4 Examples 99
7.4.1 Stanford Bunny and cow model 99
7.4.2 Rounded cube 100

8 Further Issues 105
8.1 Parameter correction 105
8.2 Bootstrapping 107

9 Conclusion and Outlook 109

Bibliography 113