

Master's thesis in
Applied Computer Science

CoolingGen

A parametric 3D-modeling software for turbine
blade cooling geometries using NURBS

June 20, 2022

Institute for Numerical and Applied Mathematics
at the Georg-August-University Göttingen

Institute for Propulsion Technology at the
German Aerospace Center in Göttingen

Bachelor's and master's theses at the Center for
Computational Sciences at the
Georg-August-University Göttingen

Julian Lüken
`julian.lueken@dlr.de`

Georg-August-University Göttingen
Institute of Computer Science

☎ +49 (551) 39-172000

☎ +49 (551) 39-14403

✉ office@cs.uni-goettingen.de

www.informatik.uni-goettingen.de

I hereby declare that this thesis has been written by myself and no other resources than those mentioned have been used.

A handwritten signature in blue ink, appearing to read 'Lüken', written in a cursive style.

Göttingen, June 20, 2022

Contents

1	Introduction	1
1.1	Motivation	1
1.2	Bézier Curves and Surfaces	1
1.2.1	Definition	1
1.2.2	De Casteljau’s Algorithm	1
1.2.3	Properties	1
2	Non-Uniform Rational B-Splines	2
2.1	Definition	2
2.1.1	NURBS Curve	2
2.1.2	NURBS Surface	2
2.2	De Boor’s Algorithm	2
2.3	Properties	2
2.4	Common Methods on NURBS Objects	2
3	Cooling Geometries	3
3.1	Chambers	3
3.2	Turnarounds	3
3.3	Slots	3
3.4	Film Cooling Holes	3
3.5	Impingement Inserts	3
4	Open CASCADE	4
5	Discussion	5
5.1	Grid-Searching With CoolingGen	5
5.2	Things Desired	5

Chapter 1

Introduction

1.1 Motivation

1.2 Bézier Curves and Surfaces

1.2.1 Definition

1.2.2 De Casteljau's Algorithm

1.2.3 Properties

Chapter 2

Non-Uniform Rational B-Splines

2.1 Definition

2.1.1 NURBS Curve

2.1.2 NURBS Surface

2.2 De Boor's Algorithm

2.3 Properties

2.4 Common Methods on NURBS Objects

Chapter 3

Cooling Geometries

3.1 Chambers

3.2 Turnarounds

3.3 Slots

3.4 Film Cooling Holes

3.5 Impingement Inserts

Chapter 4

Open CASCADE

Chapter 5

Discussion

5.1 Grid-Searching With CoolingGen

5.2 Things Desired