

Evaluation of the Performance of Randomized FFD Control Grids

Master Thesis

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by

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1 How to read this Thesis

As a guide through the nomenclature used in the formulas we prepend this chapter.

Unless otherwise noted the following holds:

- lowercase letters x, y, z
refer to real variables and represent a point in 3D-Space.
- lowercase letters u, v, w
refer to real variables between 0 and 1 used as coefficients in a 3D B-Spline grid.
- other lowercase letters
refer to other scalar (real) variables.
- lowercase **bold** letters (e.g. \vec{x}, \vec{y})
refer to 3D coordinates
- uppercase **BOLD** letters (e.g. D, M)
refer to Matrices

2 Introduction

In this Master Thesis we try to extend a previously proposed concept of predicting the evolvability of Freeform-Deformation (FFD) given a Deformation-Matrix[1]. In the original publication the author used random sampled points weighted with Radial Basis Function (RBF) to deform the mesh and defined three different criteria that can be calculated prior to using an evolutionary optimisation algorithm to assess the quality and potential of such optimisation.

We will replicate the same setup on the same meshes but use Freeform-Deformation (FFD) instead of Radial Basis Function (RBF) to create a deformation and evaluate if the evolution-criteria still work as a predictor given the different deformation.

2.1 What is Freeform-Deformation (FFD)?

First of all we have to establish how a FFD works and why this is a good tool for deforming meshes in the first place.

2.2 Was ist evolutionäre Optimierung?

2.3 Wieso ist evo-Opt so cool?

2.4 Evolvierbarkeitskriterien

- Konditionszahl etc.

3 Hauptteil

3.1 Was ist FFD?

- Definition
- Wieso Newton-Optimierung?
- Was folgt daraus?

3.2 Szenarien vorstellen

3.2.1 1D

Optimierungsszenario

- Ebene -> Template-Fit

Matching in 1D

- Trivial

Besonderheiten der Auswertung

- Analytische Lösung einzig beste
- Ergebnis auch bei Rauschen konstant?
- normierter 1-Vektor auf den Gradienten addieren
 - Kegel entsteht

3.2.2 3D

Optimierungsszenario

- Ball zu Mario

Matching in 3D

- alternierende Optimierung

Besonderheiten der Optimierung

- Analytische Lösung nur bis zur Optimierung der ersten Punkte gültig
- Kriterien trotzdem gut

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4 Evaluation

4.1 Spearman/Pearson-Metriken

- Was ist das?
- Wieso sollte uns das interessieren?
- Wieso reicht Monotonie?
- Haben wir das gezeigt?
- Statistik, Bilder, blah!

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5 Schluss

HAHA .. als ob -.-

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Appendix

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Bibliography

- [1] RICHTER, Andreas ; ACHENBACH, Jascha ; MENZEL, Stefan ; BOTSCH, Mario: Evolvability as a Quality Criterion for Linear Deformation Representations in Evolutionary Optimization. In: *IEEE Congress on Evolutionary Computation*, IEEE, 2016

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Abbreviations

FFD Freeform-Deformation

DM-FFD Direct Manipulation Freeform-Deformation

RBF Radial Basis Function

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List of Algorithms

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List of Figures

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List of Tables

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Todo list

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Erklärung

I hereby declare that this thesis is my own work and effort. Where other sources of information have been used, they have been acknowledged. blah blah

Bielefeld, den August 28, 2017

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