UNIVERSITÄT
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Open-Minded

Dissertation

Thesis name

From the Faculty of Physics
the University of Duisburg-Essen
approved dissertatio
to obtain the degree
Dr. rer. nat.
from

M. Sc. Name
from Birthplace

Advisor:
Ph. D. xxx
Co-advisor:
Ph. D. yyy

Duisburg, Germany
20xx

UNIVERSITÄT
DUISBURG
ESSEN

Offen im Denken

Dissertation

German Thesis name

Von der Fakultät für Physik
der Universität Duisburg-Essen
genehmigte Dissertation
zur Erlangung des Grades
Dr. rer. nat.
von

M. Sc. Name
aus Birthplace

Gutachter:
Ph. D. xxx
Gutachter:
Ph. D. yyy

Duisburg, Deutschland
20xx

A nice quote ...

Hiermit versichere ich, die vorliegende Dissertation selbstständig, ohne fremde Hilfe und ohne Benutzung anderer als den angegebenen Quellen angefertigt zu haben. Alle aus frem- den Werken direkt oder indirekt übernommenen Stellen sind als solche gekennzeichnet. Die vorliegende Dissertation wurde in keinem anderen Promotionsverfahren eingereicht. Mit dieser Arbeit strebe ich die Erlangung des akademischen Grades Doktor der Naturwis- senschaften (Dr. rer. nat.) an.

Ort, Datum	Author name (on the line the signature)

Acknowledgments

Some nice words to everyone ...

Name
Year

Abstract

Abstract of the thesis.
Keywords: some keywords.

Zusammenfassung

Abstract of the thesis auf Deutsch.
Schlüsselwörter: manche Schlüsselwörter.

List of publications

Publications

Author contributions

Contributions

List of Symbols

Symbols with Latin letters

Symbol	Denomination	IS Unit	Definition
E	Energy	J	Eq. (2-1)
F	Force	N	Eq. (2-2)

Symbols with Greek letter

Symbol	Denomination	IS Unit	Definition
θ	Tilt angle	1	Eq. (2-3)

Abbreviations

Abbreviation	Denomination
$1D$	One-dimensional
$2D$	Two-dimensional
$3D$	Three-dimensional
AFM	Atomic Force Microscope
MEB	Microscopio Electrónico de Barrido
$RANSAC$	Random Sample Consensus
SEM	Scanning Electron Microscopy
STM	Scanning Tunneling Microscope
SNR	Signal-to-Noise Ratio
$SURF$	Speeded-Up Robust Features

Abbreviation	**Denomination**
SD	Standard Deviation
SAD	Sum of Absolute Differences

Contents

1. Introduction

1.1. Section

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Figure **1-1**.: A nice plot

- First item in a list
- Second item in a list
- Third item in a list
- Fourth item in a list
- Fifth item in a list

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all

letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{i=n} x_i = \frac{x_1 + x_2 + \ldots + x_n}{n}$$

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$$\int_0^\infty e^{-\alpha x^2}\mathrm{d}x = \frac{1}{2}\sqrt{\int_{-\infty}^{\infty} e^{-\alpha x^2}\mathrm{d}x \int_{-\infty}^{\infty} e^{-\alpha y^2}\mathrm{d}y} = \frac{1}{2}\sqrt{\frac{\pi}{\alpha}}$$

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$$\sum_{k=0}^{\infty} a_0 q^k = \lim_{n\to\infty} \sum_{k=0}^{n} a_0 q^k = \lim_{n\to\infty} a_0 \frac{1-q^{n+1}}{1-q} = \frac{a_0}{1-q}$$

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-p \pm \sqrt{p^2 - 4q}}{2}$$

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font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

$$\frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} + \frac{\partial^2 \Phi}{\partial z^2} = \frac{1}{c^2} \frac{\partial^2 \Phi}{\partial t^2}$$

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1. First item in a list
2. Second item in a list
3. Third item in a list
4. Fourth item in a list
5. Fifth item in a list

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

First item in a list

Second item in a list

Third item in a list

Fourth item in a list

Fifth item in a list

2. Data sets

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

This is the second paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

After this fourth paragraph, we start a new paragraph sequence. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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Some citation [1, 4, 3]. Also in [2].

$$E = mc^2 \tag{2-1}$$

and

$$F = ma \tag{2-2}$$

and

$$\theta = \sin^{-1}(x) \tag{2-3}$$

A. Affine Transformation

An Affine Transformation is any transformation that can be expressed in the form of a matrix multiplication (linear transformation) followed by a vector addition (translation).
The Affine Transformation preserves collinearity (i.e., all points lying on a line initially still lie on a line after transformation) and ratios of distance (e.g., the midpoint of a line segment remains the midpoint after transformation).
Geometric contraction, expansion, dilation, reflection, rotation, shear, similarity transformations, spiral similarities, and translation are affine transformations, as are their combinations.

Definition 1. Affine Transformation in 2D space
Consider a point $\mathbf{x} = (x, y)$. Affine transformations of $\mathbf{x}$ are all transforms that can be written

$$\mathbf{x}' = \begin{bmatrix} ax + by + c \\ dx + ey + f \end{bmatrix}$$

where a through f are scalars.

Example 2. Affine transformations
If $a, e = 1$, and $b, d = 0$, then we have a pure translation

$$\mathbf{x}' = \begin{bmatrix} x + c \\ y + f \end{bmatrix}$$

If $b, d = 0$ and $c, f = 0$ then we have a pure scaling

$$\mathbf{x}' = \begin{bmatrix} ax \\ ey \end{bmatrix}$$

If $a, e = \cos\theta$, $b = -\sin\theta$, $d = \sin\theta$, and $c, f = 0$, we have a rotation

$$\mathbf{x}' = \begin{bmatrix} x\cos\theta - y\sin\theta \\ x\sin\theta + y\cos\theta \end{bmatrix}$$

Finally, if $a, e = 1$, and $c, f = 0$ we have the shear transform

$$\mathbf{x}' = \begin{bmatrix} x + by \\ y + dx \end{bmatrix}$$

B. Horizontal Disparity into Heights

The heights of the 3D models are calculated using the tilt of the sample during the image acquisition. Using the reference plane concept, a point in the image located on the reference plane remains at the same position after the tilting. On the other hand, a point above or below the reference plane will have an horizontal displacement.
Having in mind the relation between the points in the two frames of inclination, it is possible to establish the following relation

$$\Delta a + \Delta c = \Delta a' + \Delta c' \rightarrow |\Delta a - \Delta a'| = |\Delta c - \Delta c'| = r \tag{B-1}$$

and finally, changing to the image plane

$$h = \frac{d \cdot p}{2 \sin\left(\frac{\theta}{2}\right)} \tag{B-2}$$

where h is the height, d the disparity in microns, θ is the total tilt angle and p the pixel size in sample units (e.g. microns)

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