TECHNISCHE UNIVERSITNCHEN

Chair of Forest Growth and Yield Science

DIGITAL AERIAL PHOTOGRAMMETRY FOR ESTIMATING FOREST INVENTORY ATTRIBUTES — APPLICATIONS FOR SPATIAL AND TEMPORAL ANALYSIS

CHRISTOPH STEPPER

Complete copy of the dissertation approved by the TUM School of Life Sciences Weihenstephan of the Technische Universitnchen in partial fulfillment of the requirements for the degree of

Doktor der Naturwissenschaften (Dr. rer. nat.)

Chair:		Univ.-Prof. Dr.-Ing. Stephan Pauleit
Dissertation examiners:	1.	Univ.-Prof. Dr. Dr. h.c. Hans Pretzsch
	2.	Univ.-Prof. Dr. Thomas Knoke
	3.	Univ.-Prof. Dr. Clement Atzberger Universitr Bodenkultur Wien)

The dissertation was submitted to the Technische Universit**Stepper.2016**nchen on 18th March 2016 and accepted by the TUM School of Life Sciences Weihenstephan on _____ .

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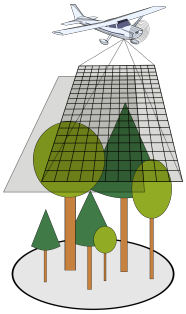

DISSERTATION

Wissenschaftszentrum Weihenstephan
Technische Universität München

Freising
March 2016

Christoph Stepper: *Digital Aerial Photogrammetry for estimating Forest Inventory Attributes — applications for Spatial and Temporal Analysis,*
Dissertation, © March 2016.

E-MAIL:
c.stepper@mytum.de

SUPERVISOR:
Prof. Dr. Dr. h.c. Hans Pretzsch

The title page shows an artwork displaying the acquisition of overlapping digital aerial images and trees measured on ground plot (own drawing).
This document was set in .

I have found the best way to give advice to your children
is to find out what they want and then advise them to do it.

— Harry S. Truman

Dedicated to the loving parents Elisabeth and Ludwig Stepper.

ABSTRACT

Information about canopy height and spatial structure is essential for various tasks in forest planning and management. Retrieving this information from remote sensing data has been focus in research as this technique opens the possibility to assess large forested areas. The work presented in this thesis focussed on utilizing digital aerial imagery from airborne platforms to generate accurate measurements of canopy height by means of image matching algorithms. Together with ground information, necessary for model calibration, different forest inventory attributes can be assessed ...

ZUSAMMENFASSUNG

Informationen ber die Bestandeshhe und die rliche Verteilung der Be in einem Bestand ...

PUBLICATIONS

List of scientific papers from the thesis

This dissertation was done in a publication-based manner. The developed methods, results, and findings were published in different scientific papers:

In general, the remote sensing problem
can be presented as inferring the order
in the properties and distributions of matter
and energy in the scene from the set
of measurementes comprising the image.

— **Strahler:1986** (**Strahler.1986**)

ACKNOWLEDGEMENTS

I would like to take the opportunity to thank all those involved in the work I did in the last years. Without your help and support, I would not have been able to mastering the challenges on my way to this thesis.

First of all, I express my gratitude to Prof. Dr. Hans Pretzsch, who complied to supervise me as external PhD Student at Technische Universität München. He ...

I gratefully acknowledge . . . I am furthermore thankful to . . . Many thanks go to . . .

I thank all my colleagues at the LWF, in particular ...,

for their invaluable aid during working on the different aspects of this thesis. ... the precision in the suggestions, the good advices.

Personensammlung:

- Prof. Dr. Thomas Knoke für die Übernahme der Zweitkorrektur
- Prof. Dr. Stephan Pauleit für den Vorsitz der Prüfungskommision
- Prof. Dr. Clement Atzberger für die Übernahme der Zweitkorrektur und viele hilfreiche Hinweise und Diskussionen
- Dr. Christoph Straub
- Rudolf Seitz
- Helena Löffler, Kristine Meyerhofer, Oliver Bauer and the other colleagues at LWF
- Michael Suda fürs Laufen
- Markus Immitzer
- Lars Waser
- Joanne White and Mike Wulder
- Nicholas Coops and Piotr Tompalski plus the complete crowd of IRSS
- Brynn McMillan for sharing a great time in Vancouver
- Laura Carlson for language editing
- . . .

Finally, thanks to Melanie. You always believed in me. I'm so happy that you're with me.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LISTINGS

ACRONYMS

1 INTRODUCTION

Digital aerial photogrammetry experienced increased attention during the last decade.

1.1 STATE OF THE ART

Literature review on remote sensing applications in forestry. Historic development of aerial imagery for use in forest inventory and management planning.

Early developments of aerial photogrammetry for height retrieval - theoretical framework

3d remote sensing technologies: Airborne laser scanning as method of choice.

Here we want to cite **Stepper.2015b**

1.2 RESEARCH OBJECTIVES

The research presented in this thesis focussed on the following objectives:

1. Are digital aerial images acquired within the standardized administrative aerial surveys suitable to computed dense image-based point clouds or digital surface models, that characterize the forests' surface with a sufficient level of detail?
2. Can Semi-global matching point clouds, normalized to heights above ground using ALS-based DTMs, be used to model key forest inventory attributes, e.g. gross volume?
3. Are repeated aerial image acquisitions and the derived CHMs capable to assess canopy height changes is a complex temperate forest?