



Universiteit  
Leiden  
The Netherlands

## Algebraic filters for filtered backprojection

Plantagie, L.

### Citation

Plantagie, L. (2017, April 13). *Algebraic filters for filtered backprojection*. Retrieved from <https://hdl.handle.net/1887/48289>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/48289>

**Note:** To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/48289> holds various files of this Leiden University dissertation

**Author:** Plantagie, L.

**Title:** Algebraic filters for filtered backprojection

**Issue Date:** 2017-04-13

# ALGEBRAIC FILTERS FOR FILTERED BACKPROJECTION

Proefschrift

ter verkrijging van  
de graad van Doctor aan de Universiteit Leiden,  
op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker,  
volgens besluit van het College voor Promoties  
te verdedigen op donderdag 13 april 2017  
klokke 13:45 uur

door

Linda Plantagie

geboren te Nieuwegein  
in 1986

Promotor: Prof. dr. Kees Joost Batenburg

Samenstelling van de promotiecommissie:

Voorzitter: Prof. dr. A. W. van der Vaart

Secretaris: Prof. dr. B. de Smit

Overige leden: Prof. dr. R. H. Bisseling (Universiteit Utrecht)  
Prof. dr. J. Sijbers (Universiteit Antwerpen)  
Dr. E. Van de Castele (AZ Monica, Antwerpen)

# **ALGEBRAIC FILTERS FOR FILTERED BACKPROJECTION**

ISBN: 978-94-6299-548-2

© Linda Plantagie, Leiden 2017

Cover design by Ridderprint BV, Ridderkerk  
Printed by Ridderprint BV, Ridderkerk

The research in this thesis has been financially supported by the Netherlands Organisation for Scientific Research (NWO), project 639.072.005.

---

# CONTENTS

---

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	X-ray Transmission Computed Tomography . . . . .	1
1.2	FBP . . . . .	4
1.3	Algebraic reconstruction methods . . . . .	6
1.4	Preview . . . . .	8
<b>2</b>	<b>Fast Approximation of Algebraic Reconstruction Methods for Tomography</b>	<b>13</b>
2.1	Introduction . . . . .	14
2.2	The Filtered Backprojection algorithm . . . . .	16
2.3	Algebraic reconstruction algorithms . . . . .	19
2.4	Algebraic filters . . . . .	21
2.5	Experiments . . . . .	23
2.6	Results . . . . .	27
2.7	Conclusions . . . . .	42
<b>3</b>	<b>Spatial Variations in Reconstruction Methods for CT</b>	<b>47</b>
3.1	Introduction . . . . .	48
3.2	Method . . . . .	49
3.3	Experiments . . . . .	51
3.4	Results . . . . .	53
3.5	Discussion and Conclusions . . . . .	57
<b>4</b>	<b>Approximating Algebraic Tomography Methods by Filtered Backprojection: a Local Filter Approach</b>	<b>59</b>
4.1	Introduction . . . . .	60
4.2	Introduction to AF-FBP . . . . .	62
4.3	AF-FBP with multiple filters . . . . .	64
4.4	Experiments . . . . .	65
4.5	Results . . . . .	69
4.6	Discussion . . . . .	80
4.7	Conclusions . . . . .	81

---

<b>5</b>	<b>Algebraic Filter Approach for Fast Approximation of Non-linear Tomographic Reconstruction Methods</b>	<b>85</b>
5.1	Introduction . . . . .	86
5.2	Preliminaries . . . . .	89
5.3	Algebraic Filters for FBP . . . . .	94
5.4	Experiments . . . . .	97
5.5	Discussion and Conclusions . . . . .	109
<b>6</b>	<b>Filtered Backprojection using Algebraic Filters; Application to Biomedical Micro-CT Data</b>	<b>115</b>
6.1	Introduction . . . . .	116
6.2	The AF-FBP method . . . . .	118
6.3	Experiments . . . . .	119
6.4	Results . . . . .	121
6.5	Conclusions and discussion . . . . .	123
<b>7</b>	<b>The accuracy of FBP with recently introduced filters: a comparison</b>	<b>125</b>
7.1	Introduction . . . . .	125
7.2	Methods . . . . .	127
7.3	Experiments . . . . .	138
7.4	Results . . . . .	141
7.5	Discussion and Conclusions . . . . .	149
	<b>Samenvatting</b>	<b>153</b>
	<b>Curriculum Vitae</b>	<b>159</b>
	<b>Acknowledgement</b>	<b>161</b>