



Universiteit  
Leiden  
The Netherlands

## **Spatio-temporal gene expression analysis from 3D in situ hybridization images**

Welten, M.C.M.

### **Citation**

Welten, M. C. M. (2007, November 27). *Spatio-temporal gene expression analysis from 3D in situ hybridization images*. Leiden Institute of Advanced Computer Science, group Imaging and Bio-informatics, Faculty of Science, Leiden University. Retrieved from <https://hdl.handle.net/1887/12465>

Version: Corrected Publisher's Version

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

Downloaded from: <https://hdl.handle.net/1887/12465>

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

Spatio-temporal gene expression analysis  
from 3D *in situ* hybridization images



# Spatio-temporal gene expression analysis from 3D *in situ* hybridization images

## PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Universiteit Leiden,  
op gezag van de Rector Magnificus prof.mr. P.F. van der Heijden,  
volgens besluit van het College voor Promoties  
te verdedigen op dinsdag 27 november 2007  
klokke 16.15 uur

door  
Monica Cornelia Maria Welten  
geboren te Heemstede  
in 1960

## PROMOTIECOMMISSIE

*Promotores*

Prof. Dr. S.M. Verduyn Lunel

Prof. Dr. H.P. Spaink

*Co-promotor*

Dr. Ir. F.J. Verbeek

*Referent*

Prof. Dr. C.A. Tickle (University of Bath, UK)

*Overige leden*

Prof. Dr. A.J. Durston

Prof. Dr. A.P.J.M. Siebes (Universiteit Utrecht)

Prof. Dr. M.K. Richardson

Dr. H. Berkhoudt

Dr. A.H. Meijer

This study was financially supported by Netherlands Research Council through the BioMolecular Informatics programme of Chemical Sciences (grant number #050.50.213). The preparation of the thesis was supported by grants from **ZFScreens BV**.



Aan Jan en Frieda Welten - Hund

Aan Wim Welten



# Spatio-temporal gene expression analyses from 3D *in situ* hybridization images

## Contents

<i>Chapter 1</i>	<b>General introduction</b>	<b>9</b>
<b>A tool to visualize gene expression:</b>		
<i>Chapter 2</i>	<b>ZebraFISH: Fluorescent in situ hybridization protocol and 3 D imaging of gene expression patterns.</b>	<b>19</b>
<b>Case study – early zebrafish development</b>		
<i>Chapter 3</i>	<b>Expression analysis of genes encoding 14-3-3 gamma and tau proteins using the 3D digital atlas of zebrafish development</b>	<b>33</b>
<i>Chapter 4</i>	<b>3D Reconstruction of gene expression patterns in the developing innate immune system of the zebrafish</b>	<b>53</b>
<b>Case study – late zebrafish and cross species development</b>		
<i>Chapter 5</i>	<b>Gene expression and digit homology in the chicken wing</b>	<b>69</b>
<i>Chapter 6</i>	<b>Application of frequent episode mining in developmental pattern analysis, based on gene expression and morphological characters.</b>	<b>87</b>
<i>Chapter 7</i>	<b>Discussion and conclusions</b>	<b>105</b>
	<b>References</b>	<b>115</b>
	<b>Summary</b>	<b>133</b>
	<b>Samenvatting</b>	<b>137</b>
	<b>Curriculum vitae</b>	<b>143</b>
	<b>Color supplement</b>	<b>145</b>



