Contents

Preface

vii

1	Introduction					
	1.1	Astronomy and the scientific method				
	1.2	Convolutions in astronomy	1			
	1.3	The essence of the deconvolution problem				
2	Some Linear Integral Equations and their Occurrence in					
	Astronomy					
	A:	Fredholm equations				
	2.1	Definitions and notation	1			
	2.2	The Fourier convolution	1			
	2.3	The Laplace transform	2			
	2.4	The Planck and related transforms	2			
3	Some Linear Integral Equations and their Occurrence in					
	Astronomy					
		Volterra equations	3			
	3.1	Introductory remarks	3			
	3.2	Non-thermal bremsstrahlung spectra	-			
	3.3	Solar flare heating by an electron beam	3			
	3.4	Stellar density in a globular cluster	3			
	3.5	Distribution of stellar rotation velocities	3			
	3.6	Mass distribution in the galactic disc	3			
		Mathematical Aspects of the Inversion Problem				
4	Math	ematical Aspects of the Inversion Problem				
4	Math 4.1	ematical Aspects of the Inversion Problem Introduction	4			

4.2 Integral equations of the first and second kinds 44

Contents

	4.3	The ill posed inversion problem	47		
	4.4	Numerical differentiation and singular Volterra equations of the first kind	55		
5	Class	ical Methods of Numerical Inversion			
	5.1	Introduction	58		
	5.2	Numerical inversion methods	59		
	5.3	Instability of the numerical system	63		
	5.4	Inversion of Abel's equation in the presence of data			
		noise	70		
	5.5	Note on solution in terms of integral moments	77		
6	Non-Classical Inversion and Stabilisation Techniques				
	6.1	The failure of classical techniques and the			
		information content of the data	80		
	6.2	The method of regularisation	83		
	6.3	Other non-classical inversion techniques	90		
	6.4	Summary	98		
7	Numerical Examples				
	7.1	Introduction	100		
	7.2	Filtering by Laplace type kernels and the			
		information content of the data	101		
	7.3	Application A: inversion of Bremsstrahlung			
		continuum spectra	103		
	7.4	Application B: electron spectra from synchrotron			
		spectra	120		
	7.5	Overview of numerical solutions	134		
8	Discu	ssion, Conclusions and Recommended Strategy	136		
References			143		
Ind	Index				

vi