

Contents

0	Introduction	10
1	A Generalization of Prony's Method	11
1.1	Original Prony Method	11
1.2	The Generalized Prony Method	15
1.3	Generalized Eigenfunctions	19
2	Generalized Prony Method for Unknown Order of Sparsity M	22
3	Numerical Behavior of the Prony Method	32
3.1	Prony-like Methods	33
3.2	ESPRIT	36
3.3	Matrix Pencil	38
3.4	MUSIC	40
3.5	Stability of the Approximate Prony Method	44
3.6	Numerical Tests for Different Methods	46
4	Reconstruction of Sparse Expansions of Eigenfunctions of Linear Operators	51
4.1	Prony Method for Eigenfunctions of the Translation Operator	51
4.1.1	Symmetric Prony Polynomials	55
4.2	Prony Method for Eigenfunctions of the Dilatation Operator	62
4.3	Prony Method for the Sturm-Liouville Operator	67
4.4	Prony Method for Finite Dimensional Linear Operators	75
4.4.1	Comparison with Compressed Sensing	77
4.5	Prony Method for the Differential Operator	80
5	Extending the Generalized Prony Method	83
5.1	Freedom of Choice in the Functional F	83
5.2	Multivariate Version of the Generalized Prony Method	92
5.3	Analyzing Translations of Multivariate Gaussians in Time Domain	92
6	Applications of the Prony Method	99
6.1	Prony Method after Preprocessing	99
6.2	Nondestructive Material Examination	102
7	Open Problems	107
7.1	Denoising with Regularization	107
7.2	Prony Method for Not Exactly Sparse Functions	109
7.3	Negative Results	110
7.3.1	Approximating Derivatives of Orthogonal Polynomials	110