

On weighted Strand's iteration

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ABSTRACT.

In this paper we present a generalization of Strand's iterative method for numerical approximation of the weighted minimal norm solution of a linear least squares problem. We prove convergence of the extended algorithm, and show that previous iterative algorithms proposed by L. Landweber, J. D. Riley and G. H. Golub are particular cases of it.

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REFERENCES

- [1] Golub, G. H., *Numerical methods for solving linear least squares problems*, Numer. Math., 7 (1965), No. 3, 206–216
- [2] Koestler H. et al., *On Kaczmarz's projection iteration as a direct solver for linear least squares problems*, Linear Algebra and its Applications, 436 (2012), No. 2, 389–404
- [3] Landweber, L., *An Iteration Formula for Fredholm Integral Equations of the First Kind*, American J. of Math., 73 (1951), No. 3, 615–624
- [4] Paige, C. C. and Saunders, M. A., *Towards a generalized singular value decomposition*, SIAM J. Numer. Analysis, 18 (1981), No. 3, 398–405
- [5] Popa, C. and Preclik, T., *Resolving ill-posedness of Rigid Multibody Dynamics*, Tech. Rep. 10-11 (2010), Lehrstuhl für Informatik 10 (Systemsimulation), FAU Erlangen-Nürnberg
- [6] Popa, C. and Zdunek, R., *Kaczmarz extended algorithm for tomographic image reconstruction from limited-data*, Mathematics and Computers in Simulation, 65(6)(2004), 579-598.
- [7] Popa, C., *Projection algorithms - classical results and developments. Applications to image reconstruction*, Lambert Academic Publishing - AV Akademikerverlag GmbH & Co. KG, Saarbrücken, Germany, 2012.
- [8] Riley, J. D., *Solving Systems of Linear Equations With a Positive Definite, Symmetric, but Possibly Ill-Conditioned Matrix*, Mathematical Tables and Other Aids to Computation, 9 (1955), No. 51, 96–101
- [9] Strand, O. N., *Theory and methods related to the singular-function expansion and Landwebers iteration for integral equations of the first kind*, SIAM J. Numer. Analysis, 11 (1974), No. 4, 798–825
- [10] van Loan, C. F., *Generalizing the singular value decomposition*, SIAM J. Numer. Analysis, 13 (1976), No. 1, 76–83

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