

An improved method to solve a fuzzy linear system in the fuzzy finite element method

Koen Ovaere

Ghent University, Department of Applied Mathematics and Computer Science, Fuzziness and Uncertainty Modelling Research Unit, Krijgslaan 281 S9, 9000 Ghent, Belgium
koen.ovaere@UGent.be

Keivan Shariatmadar

Ghent University, Department of Electrical energy, systems and automation, SYSTeMS Research Group, Technologiepark 914, B-9052 Zwijnaarde, Belgium
keivan.shariatmadar@UGent.be

Dr. Glad Deschrijver

Ghent University, Department of Applied Mathematics and Computer Science, Fuzziness and Uncertainty Modelling Research Unit, Krijgslaan 281 S9, 9000 Ghent, Belgium
glad.deschrijver@UGent.be

Prof. Dr. Etienne E. Kerre

Ghent University, Department of Applied Mathematics and Computer Science, Fuzziness and Uncertainty Modelling Research Unit, Krijgslaan 281 S9, 9000 Ghent, Belgium
etienne.kerre@UGent.be

Abstract

In this paper we present a new method to solve the fuzzy linear system in the Fuzzy Finite Element Method (FFEM). We make use of an approach presented by A. Vroman, G. Deschrijver and E.E. Kerre. [1] to solve general fuzzy linear systems. This method is based on parametric functions and has an exponential time complexity in the number of fuzzy numbers in the fuzzy linear system. By taking the recurrence of fuzzy variables, sometimes under a different form, in the linear system within the FFEM into account, we can optimize this method depending on the level of recurrence of those fuzzy variables. The method remains exponentially in time but the exponent depends on the level of recurrence of the fuzzy variables. The base is greater than the base in the original method, which was 2, because of the loss of monotonicity in the parametric functions, but the cost to construct those parametric functions from the fuzzy linear system is higher in our modified approach. This is compensated by taking the dependencies between the fuzzy numbers into account. Additionally, we suggest some extensions to re-use the solution of one fuzzy linear system matrix to calculate an approximative solution and compare it with the original one.

References

- [1] A. Vroman, G. Deschrijver and E. E. Kerre: Using parametric functions to solve systems of linear fuzzy equations—An improved algorithm. Proceedings of the 7th International FLINS Conference Applied Artificial Intelligence, Vol. 7, pp. 43-50, 2006.