Project title:

Approximations by max-product nonlinear operators and by distance methods in the theory of fuzzy numbers, applied to signal and image processing

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Project Summary

The first main goal of this project is to continue our research on the newly introduced max-product-type approximation. We are interested in inverse and saturation results for various max-product operators of Bernstein, of interpolatory and of Whittaker types, in max-product-type quadrature formulas, max-product-type Weierstrass functions, etc. The second goal is to continue the researches of our team concerning the approximation of fuzzy numbers by simpler classes of fuzzy numbers. Important contributions with respect to computation, general properties and metric properties of the approximations, with applications to the ranking of fuzzy numbers will be considered. The third goal is to connect the previous two directions, approximating the fuzzy numbers by max-product nonlinear operators, such that many properties like the preservation of support, parameters, continuity, alpha levels, translation and scalar invariance be satisfied. The applications of max-product nonlinear approximation operators to image and signal processing are especially considered. Then, concerning the approximation of fuzzy numbers, the important problem whether it is better to simplify initial data before or after using an aggregation operator is addressed. The research is in progress with respect to many of the previously mentioned objectives and the results are very promising.

Main results in the project (5.10.2011-20.10.2013)

I. Papers published or accepted for publication :

1. Coroianu, L. and Gal, S.G., Approximation by max-product sampling operators based on sinc-type kernels, Sampling Theory in Signal and Image Processing, 10 (2011), pp. 211-230 (Mathematical Reviews & Zentralblatt fur Mathematik) (**Scimago Journal & Coutry Rank/SJR 0.043**).

2. Coroianu, L., Lipschitz functions and fuzzy number approximations, Fuzzy Sets and Systems, 200 (2012), pp. 116-135 (**impact factor 1.759, score of relative influence 1.04973**).

3. Ban, A.I. and Ban, O., Optimization and extensions of a fuzzy multicriteria decision making method and applications to selection of touristic destinations, Expert Systems with Applications, 39 (2012), pp. 7216-7225 (**impact factor 2.203, score of relative influence 1.02265**).

4. Farhadinia, B. and Ban, A.I., Developing new similarity measures of generalized intuitionistic fuzzy numbers and generalized interval-valued fuzzy numbers from similarity measures of generalized fuzzy numbers, Mathematical and Computer Modeling, 57 (2013), pp. 812-825 (**impact factor 1.346, score of relative influence 0.88819**).

5. Ban, A. and Coroianu, L., Nearest interval, triangular and trapezoidal approximations of a fuzzy number preserving ambiguity, International Journal of Approximate Reasoning, 53 (2012), pp. 805-836 (**impact factor 1.948, score of relative influence 1.13384**).

6. Balaj, M., Coroianu, L., Gal, S. G. and Muresan, S., Iterations and fixed points for the Bernstein max-product operator, Fixed Point Theory (Cluj), 14 (2013), pp. 39-52**.** (**impact factor 0.779, score of relative influence: 0.238**).

7. Ban, A., Bica, A. and Coroianu, L., Metric properties of the extended weighted semi-trapezoidal approximations of fuzzy numbers and their applications, S. Greco et al. (Eds.), IPMU 2012, Part III, Advances in Computational Intelligence, Commmunications in Computer and Information Science, vol. 299, pp. 29-38, Springer-Verlag, Berlin, Heidelberg, 2012 (**ISI Proceedings**).

8. Ban, A. and Coroianu, L., Weighted semi-trapezoidal approximation of a fuzzy number preserving the weighted ambiguity, S. Greco et al. (Eds.), IPMU 2012, Part III, Advances in Computational Intelligence, Commmunications in Computer and Information Science, vol. 299, pp. 49-58, Springer-Verlag, Berlin, Heidelberg, 2012 (**ISI Proceedings**).

9. Coroianu, L., Gagolewski, M. and Grzegorzewski, P., Nearest piecewise linear approximation of a fuzzy number, Fuzzy Sets and Systems, in press, http://dx.doi.org/10.1016/j.fss.2013.02.005 (**impact factor 1.759, score of relative influence 1.04973**).

10. Coroianu, L. and Gal, S.G., Saturation results for the Lagrange max-product interpolation operator based on equidistant knots, Revue d'Analyse Numerique et Theorie Approximation (Cluj), **Editura Academiei**, Tome 41(2012), No. 1, 27-41 (Mathematical Reviews & Zentralblatt fur Mathematik).

11. Coroianu, L. and Gal, S.G., Global smoothness preservation by some nonlinear max-product operators, Matematicki Vesnik, 64 (2012), pp. 303-315 (Mathematical Reviews & Zentralblatt fur Mathematik).

12. Coroianu, L. and Gal, S.G., Saturation results for the truncated max-product sampling operators based on sinc and Fejer-type kernels, Sampling Theory in Signal and Image Processing, Vol. 11, No. 1, 2012, pp. 113-132. (Mathematical Reviews & Zentralblatt fur Mathematik). (**Scimago Journal & Coutry Rank/SJR 0.043)**

13. Coroianu, L. and Gal, S.G., Localization results for the Meyer-Konig and Zeller max-product operator, Numerical Functional Analysis and Optimization, 34(7)(2013), 713-727. (**impact factor 0.71**, **score of relative influence 0.57298**)

14. Coroianu, L. and Gal, S.G., Localization results for the Lagrange max-product interpolation operator based on equidistant knots, Revue d'Anal. Numer. Theor. Approx. (Cluj), **Editura Academiei Romane**, 42 (2013), no. 2, under press. (Mathematical Reviews & Zentralblatt fur Mathematik).

15. Bede, B., Coroianu, L. and Gal, S.G., Approximation of fuzzy numbers by max-product Bernstein operators, Fuzzy Sets and Systems, accepted for publication, available online at http://dx.doi.org/10.1016/j.fss.2013.04.010. (**impact factor 1.759, score of relative influence 1.04973)**

16. Ban, A., Coroianu, L. and Grzegorzewski, P., A fixed-shape fuzzy median of a fuzzy sample, Advances in Intelligent Systems Research (Proceedings of the 8th Conference of the European Society for Fuzzy Logic and Technology, Milano 2013), pp.215-222, Atlantis Press, 2013. (**ISI Proceedings**).

17. Coroianu, L. and Gal, S.G., Saturation and inverse results for the Bernstein max-product operator, Periodica Mathematica Hungarica, accepted for publication (**impact factor 0.261, score of relative influence: ---**)

18. Ban, A. and Coroianu, L., Existence, uniqueness and continuity of trapezoidal approximations of fuzzy numbers under a general condition, Fuzzy Sets and Systems, accepted for publication, available online at http://dx.doi.org/10.1016/j.fss.2013.07.004. (**impact factor 1.759, score of relative influence 1.04973).**

19. Coroianu, L., Fullér, R, On multiplication of interactive fuzzy numbers, 11th IEEE International Symposium on Intelligent Systems and Informatics (SISY 2013), September 26-28, 2013, Subotica, Serbia, ISBN: 978-1-4799-0305-4, pp. 181-185 (**IEEE**).

20. Coroianu, L., Fullér, R., On additivity of the weighted possibilistic mean operator, 14th IEEE International Symposium on Computational Intelligence and Informatics (CINTI 2013), November 19-21, 2013, Budapest, Hungary, acceptata (**IEEE**).

II. Papers submitted for publication :

1. Coroianu, L. and Gal, S.G., Localization results for the Bernstein max-product operator, 10 pagini.

2. Coroianu, L., Necessary and sufficient conditions for the equality of the interactive and standard sum of two fuzzy numbers, 28 pagini.

3. Bede, B., Coroianu, L. and Gal, S.G., Approximation and shape preserving properties of the max-product Bernstein operators of two variables, 20 pagini.

4. Coroianu, L. and Gal, S.G., Saturation results for the Meyer-Konig and Zeller max-product operator, 20 pagini .

5. Coroianu, L., On the continuity of solutions of quadratic programs, 22 pagini.

6. Ban, A.I. and Coroianu, L., Simplifying the search for efficient ranking of fuzzy numbers, 34 pagini.

7. Ban, A.I., Weighted semi-trapezoidal approximation of a fuzzy number preserving the alpha-level and mean core, 21 pagini.

8. Gal, S.G., A possibilistic approach of the max-product Bernstein kind operators, 10 pagini.

III. Papers and books in progress :

1. Bede, B., Coroianu, L. and Gal, S.G., Approximation by max-product triangular Bernstein operators of two variables.

2. Bede, B., Coroianu, L. and Gal, S.G. , Weierstrass functions of max-product type.

3. Bede, B., Coroianu, L. and Gal, S.G. , "Approximation by Max-Product Type Operators and Applications", **book manuscript, aprox. 419 pages**.

4. Coroianu, L., Gagolewski, M. and Grzegorzewski, P., Nearest piecewise approximation of fuzzy numbers-general case.

5. Ban, A.I., Coroianu, L. and Khastan, A., Conditioned weighted L-R approximations of fuzzy numbers.

6. Ban, A.I., Coroianu, L. and Grzegorzewski, P., "Approximations of Fuzzy Numbers and Their Applications", **book manuscript, aprox. 390 pages**.

7. Ban, A.I. and Coroianu, L., Discontinuity of the trapezoidal fuzzy number-valued operators preserving alpha-cut.

8. Ban, A.I. and Coroianu, L., Existence, uniqueness, calculus and properties of triangular approximations of fuzzy numbers under a general condition.

9. Ban, A.I. and Coroianu, L., Symmetric triangular approximations of fuzzy numbers under a general condition and properties.

10. Coroianu, L. and Stefanini, L., General approximation of fuzzy numbers by F-transform.

11. Ban, A. and Coroianu, L., Trapezoidal approximation preserving the centroid of fuzzy numbers and applications to multicriteria decision making.