

Fuzzy Differentiation Tools

Barnabas Bede
DigiPen Institute of Technology
Redmond, WA
bbede@digipen.edu

Fuzzy set theory has been providing new tools for several areas of Mathematics and Science. Fuzzy differentiation tools can be classified as fuzzy-based tools for numerical differentiation, and differentiation of fuzzy functions and fuzzy differential equations, for uncertainty quantification.

Numerical differentiation techniques based on the concept of fuzzy transform (F-transform) were recently proposed. F-transform is an integral transform based on a fuzzy partition of a certain universe of discourse, and it was generalized into the direction of F-transforms of higher degree. It is shown that higher degree F-transforms provide numerical approximation of higher order derivatives of a function, opening up new research directions in numerical differentiation. Another research direction discussed is that of fuzzy uncertainty quantification and assessment of the propagation of uncertainty in processes governed by differential equations. In this direction generalized fuzzy differentiability concepts and fuzzy differential equations are investigated. We open up the discussion about a fuzzy automatic differentiation tool, that would allow quantification of uncertainty in the automatic differentiation process.