Plenary Talk

Generalized Quadrature Formulas of Gaussian Type

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This lecture is devoted to quadrature processes of Gaussian type (cf. [1]). Beside the basic facts on the weighted Gaussian formulas on the real line and several generalizations and modifications, the connections with orthogonal polynomials and the basic procedures for their numerical and symbolic generation for arbitrary measures, including available software, are presented. Several examples with non-classical weight functions and their applications in summation of slowly convergent series, as well as to computation of some special integrals and functions are given. If the information data $\{f(x_k)\}_{k=1}^n$ in the standard n-point Gaussian quadrature formula is replaced by $\{(\mathcal{A}^{h_k} f)(x_k)\}_{k=1}^n$, where $\mathcal{A}^h$ is an extension of some linear operator $\mathcal{A}^h : \mathcal{P} \to \mathcal{P}$ ($h \geq 0$, $\mathcal{P}$ is a space of all algebraic polynomials), we get a non-standard quadrature formula [2, 3]. Typical linear operators can be an average (Steklov's) operator, some difference or differential operators. One type of these formulas based on values of certain linear differential operators at some nodes (see [4]) can be interesting in applications when the operator values are available, instead of the values of the original integrand function.

References

[1] G. Mastroianni, G.V. Milovanović, *Interpolation Processes – Basic Theory and Applications*, Springer – Verlag, Berlin – Heidelberg, Springer Monographs in Mathematics, 2008.

[2] G.V. Milovanović, A. Cvetković, *Nonstandard Gaussian quadrature formulae based on operator values*, Adv. Comput. Math. 32 (2010), pp. 431–486.

[3] G.V. Milovanović, A. Cvetković, *Gaussian quadrature rules using function derivatives*, IMA J. Numer. Anal. 31 (2011), pp. 358–77.

[4] G.V. Milovanović, M. Masjed-Jamei, Z. Moalemi, *Weighted nonstandard quadrature formulas based on values of linear differential operators*, J. Comput. Appl. Math. 409 (2022), 114162.