



**International Conference on
Numerical Analysis, Approximation
Theory and Stochastic Methods**

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BOOK OF ABSTRACTS

The Conference is dedicated to
**Professor Gheorghe Coman on the occasion of
his 90th anniversary**



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PLENARY TALKS

EXPONENTIAL DECAY OF SENSITIVITY IN GRAPH-INDEXED OPTIMIZATION PROBLEMS, SUCH AS CONTROL AND DISTRIBUTED OPTIMIZATION

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MSC: 49K40, 90C31, 93A14, 65K10

Keywords: sensitivity analysis, exponential decay, graph-indexed optimization, optimal control, distributed and decentralized optimization, overlapping Schwarz decomposition, parallel algorithms

Since 2018, with several collaborators, we have studied a phenomenon first observed in long-horizon optimal control: perturbing the data of a problem at one temporal index affects the solution at another index by an amount that decays exponentially in the distance between the two. We show this holds under uniform second-order and linear independence constraint qualifications, and extend it to spatially- and graph-indexed problems. Consequently, overlapping Schwarz-type decompositions, used as preconditioners or solution schemes, converge exponentially fast in the size of the overlap. We discuss consequences for parallel and decentralized algorithm design, with applications.

REFERENCES

- [1] S. Shin, M. Anitescu, V. M. Zavala, *Exponential Decay of Sensitivity in Graph-Structured Nonlinear Programs*, SIAM Journal on Optimization, 32 (2022), pp. 1156–1183.

CONSTRUCTION OF HUNT PROCESSES BY THE LYAPUNOV METHOD AND APPLICATIONS

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Keywords: Mehler semigroup, Hunt Markov process, fine topology, Lyapunov function, nest of compacts, stochastic differential equation, Lévy-driven Ornstein-Uhlenbeck process

Our first aim is to construct Hunt Markov processes in general state spaces, by employing the method of Lyapunov functions. The second aim is to test our techniques on generalized Mehler semigroups defined on a Hilbert space, with applications to the study of some SPDEs. The talk is based on joint works with Iulian Cîmpean (Bucharest) and Michael Röckner (Bielefeld).

MODELING GEOPHYSICAL FLUID DYNAMICS MODELS WITH FRACTIONAL BROWNIAN MOTION

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MSC: 60H15, 60G22, 76M35, 62F12

Keywords: stochastic partial differential equations, fractional Brownian motion, stochastic fluid dynamics, transport noise, stochastic vorticity equation, Hurst parameter estimation, Young integration

I will present some results related to the local wellposedness results for the vorticity equation associated to a viscous ideal fluid with transport noise driven by a fractional Brownian motion with Hurst parameter greater than $1/2$. The analysis is based on a pathwise analysis for stochastic transport-type integrals driven by fractional Brownian motion. A sewing lemma is established in a setting where both the semigroup and the integrand depend on time. The combination of semigroup smoothing, the Biot–Savart structure, and the new sewing estimates yields a contraction principle that ensures local well-posedness. I will also present an estimator for the Hurst parameter based on observing a single Fourier coefficient of the solution. This talk is based on joint work with Oana Lang (University Babes-Bolyai) and Alexandra Blessing (University of Konstanz).

ADAPTIVE HYPERPARAMETER SELECTION IN RBF APPROXIMATION AND CUBATURE

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Keywords: scattered data interpolation, partition of unity methods, radial basis functions, hyperparameter selection, leave-one-out cross-validation, numerical cubature.

Radial basis function methods depend critically on hyperparameter selection, which affects both accuracy and numerical stability. We present adaptive strategies combining leave-one-out cross-validation with derivative-free global optimization to select the RBF shape parameter. The approach is applied to global interpolation and extended to partition of unity methods for large scattered data sets. Numerical experiments show improvements in accuracy, robustness, and computational efficiency over standard selection techniques. We also consider RBF-based cubature on spherical polygons, where a LOOCV-inspired criterion selects the exponent of polyharmonic spline kernels. Applications to synthetic and geophysical data illustrate the effectiveness and flexibility of the proposed framework.

REFERENCES

- [1] R. Cavoretto, A. De Rossi, M. S. Mukhametzhanov, Y. D. Sergeyev, *On the search of the shape parameter in radial basis functions using univariate global optimization methods*, Journal of Global Optimization, 79 (2021), pp. 305–327.

MEAN-SQUARE STABILITY AND BIFURCATIONS FOR DISSIPATIVE SDES

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MSC: 60H10, 37H20, 60H35, 37H30

Keywords: stochastic differential equation, mean-square stability, stochastic bifurcation, mean-square dissipative.

We investigate the dynamics of dissipative systems with stochastic forcing and focus in particular on mean-square stability. First we identify natural conditions under which an Itô-type stochastic system is mean-square dissipative. Next we examine the linearised system and state conditions ensuring that perturbations of a linear system with affine noise are bounded. We then relate the mean-square dynamics of the nonlinear and linearised systems.

The approach gives a straightforward deterministic method to examine the effects of stochastic forcing on the stability of equilibria of deterministic systems and to obtain bifurcation diagrams that can be included into standard numerical continuation packages. The technique is illustrated numerically on some standard and non-standard examples.

The talk presents joint work with Gabriel J. Lord (Radboud University), Mariya Ptashnyk (Heriot-Watt University), and Stefanie Sonner (Radboud University).

REFERENCES

- [1] C. Kelly, G.J. Lord, M. Ptashnyk, and S. Sonner, *Mean-square Stability and Bifurcations for Dissipative SDEs*, arXiv:2604.28068 [math.PR].

ORTHOGONAL POLYNOMIALS RELATED TO A COMPLEX MOMENT FUNCTIONAL AND APPLICATIONS

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MSC: 33C45, 65D30

Keywords: complex moment functional, orthogonal polynomial, zero distribution, quadrature formula

Motivated by certain applications in physics, in particular for the computation of the so-called transition amplitudes, we study orthogonal polynomials related to a complex moment functional $L[z^k] = \mu_k$, $k = 0, 1, \dots$, defined in a suitable way (cf. [1], [2]), as well as the corresponding quadrature formulas of Gaussian and anti-Gaussian type.

REFERENCES

- [1] T. S. Chihara, *An Introduction to Orthogonal Polynomials*, Gordon & Breach, New York, 1978.
- [2] G. Mastroianni, G. V. Milovanović, *Interpolation Processes – Basic Theory and Applications*, Springer – Verlag, Berlin – Heidelberg, 2008.

LAGUERRE-BASED APPROXIMATION OF HILBERT TRANSFORMS ON $(0, +\infty)$

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MSC: 41A10, 65D30, 44A15.

Keywords: approximation by polynomials, numerical integration, Hilbert transform

The talk deals with the numerical approximation of

$$\mathcal{H}(f, t) = \int_0^\infty \frac{f(x)}{x-t} e^{-x} x^\alpha dx, \quad t > 0, \quad \alpha > -1.$$

The proposed approach is based on product integration rules obtained by approximating f through discrete de la Vallée Poussin means based on Laguerre zeros [1]. Under suitable assumptions, such polynomial sequences have uniformly bounded Lebesgue constants in spaces of locally continuous function equipped with weighted uniform norms. The convergence and stability of the resulting quadrature rules are investigated.

REFERENCES

- [1] D. Occorsio, W. Themistoclakis, *De la Vallée Poussin filtered polynomial approximation on the half-line*, Applied Numerical Mathematics (2025).

CONTRIBUTED TALKS

ON ULAM STABILITY OF THE LINEAR DIFFERENTIAL OPERATOR WITH CONSTANT COEFFICIENTS

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MSC: 34D20; 39B82.

Keywords: Linear differential operator, Ulam stability, best constant.

The n order linear differential operator with constant coefficients $D(y) = y^{(n)} + a_1y^{(n-1)} + \dots + a_ny$, $y \in \mathcal{C}^n(\mathbb{R}, X)$ acting in a Banach space X is Ulam stable if and only if the characteristic equation associated with D has no roots on the imaginary axis. We prove that if the characteristic equation has strictly positive, distinct roots r_k , $1 \leq k \leq n$ then the best Ulam constant of D is

$$K_D = \frac{1}{|V|} \int_0^\infty \left| \sum_{k=1}^n (-1)^k V_k e^{-r_k x} \right| dx,$$

where V and V_k $1 \leq k \leq n$, are Vandermonde determinants.

However, a complete solution to the problem of determining the best Ulam constant has so far been obtained only for second-order and third-order linear differential operators.

THE MAXIMAL ORDER OF CONVERGENCE OF THE GREEN'S FUNCTION METHOD FOR THE CANTILEVER BEAM EQUATION WITH DEVIATING ARGUMENT

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MSC: 34K28

Keywords: Green's function method, cantilever beam equation, iterated cubic splines

The Picard-Green's function method combined with iterated cubic splines is applied to solve the cantilever beam equation with deviating argument. The maximal fourth order of convergence in the discrete and continuous approximation of the solution is obtained and numerically tested.

REFERENCES

- [1] A. M. Bica, *On the maximal order of convergence of Green's function method for solving two-point boundary value problems with deviating argument*, Numer Algorithms, 95 (2024), pp. 943-978.
- [2] Q. Yao, *Monotonically iterative method of nonlinear cantilever beam equations*, Appl. Math. Comput., 205 (2008), 432-437.

SOME QUADRATURE FORMULAS GENERATED USING BERNSTEIN OPERATORS

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MSC: 41A55, 41A36

Keywords: quadrature formulas, Bernstein operators, linear combinations of positive linear operators, degree of exactness, order of approximation

In this article we construct quadrature formulas using the linear combination of the Bernstein operators considered in [1]. For these quadratures we determine the degree of exactness and the approximation order. We obtain representations for the remainder term. Also, some numerical results are presented.

REFERENCES

- [1] M. Frentiu, *Linear combinations of Bernstein polynomials and Mirakyan operators (Romanian)*, Studia Univ. Babes Bolyai, Series Mathematica-Mechanica, 15 (1970), No. 1, pp. 63-68.

ON THE LIMIT BEHAVIOR OF THE QUARTIC VARIATION FOR THE SOLUTION TO THE SEMILINEAR STOCHASTIC HEAT EQUATION

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MSC: 60G15, 60H05, 60G18.

Keywords: stochastic heat equation, Stein-Malliavin calculus, asymptotic independence, parameter estimation

This work concerns the limit behavior of the quartic variation (i.e., the power variation of order four) with respect to the time variable of the solution to the semilinear stochastic heat equation with space-time white noise. In a first step, we prove that this sequence satisfies a Central Limit Theorem and we deduce a similar result for the viscosity parameter estimator associated with the quartic variation. Then, by using a recent variant of the Stein-Malliavin calculus, we analyze the asymptotic independence between the quartic variation (as well as the associated viscosity parameter estimator) and the data used to construct it.

INFERENCE FOR SDES DRIVEN BY HERMITE PROCESSES

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MSC: 60G22, 62M09

Keywords: Parameter estimation, SDEs, Hermite processes, Hurst index, Hermite order

The talk will be devoted to inference methods in nonlinear stochastic differential equations with additive Hermite noise. It will be assumed that a single trajectory of the solution with a fixed finite time horizon is observed on a discrete grid and estimators of the Hurst index and diffusivity coefficient as well as an estimator of the Hermite order will be presented. The estimators are based on the weighted quadratic variation and they are weakly consistent under in-fill asymptotics (i.e. as the mesh of the observation grid tends to zero).

REFERENCES

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- [2] P. Čoupek, P. Kříž, B. Maslowski, *Parameter estimation and singularity of laws on the path space for SDEs driven by Rosenblatt processes*, Stoch. Proc. Appl. 195 (2026), 104891.

STOCHASTIC SENSITIVITY ANALYSIS OF OPTIMAL CONTROL STRATEGIES FOR AN EBOLA EPIDEMIC MODEL

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MSC: 49J15, 49K15, 92B05, 93C15

Keywords: ebola epidemic model, optimal control, stochastic sensitivity analysis, parameter uncertainty, numerical simulation

We consider an SEIR mathematical model for Ebola virus disease with vaccination and medical treatment as control measures. The corresponding optimal control problem aims to reduce the infectious population while accounting for recovery and treatment costs.

The study focuses on the effect of uncertainty in epidemiological parameters on the resulting intervention strategies. Selected parameters are treated as uncertain quantities, and stochastic sensitivity analysis together with numerical simulations is used to investigate their influence on the disease dynamics and on the timing and intensity of the optimal controls. The analysis is intended to identify influential parameters and to assess the robustness of the optimal strategies under varying epidemiological conditions.

OPTIMAL CONTROL OF A FRACTIONAL NOISE-PERTURBED NONLINEAR SCHRÖDINGER EQUATION

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MSC: 60G22, 60H15, 62P35, 93E20

Keywords: stochastic Schrödinger equations, fractional Brownian motion, optimal control

An optimal control problem for a class of stochastic nonlinear Schrödinger equations driven by multiplicative fractional Brownian motion with Hurst index $H \in (0, 1)$ is studied. Using a separation approach, variational solutions are represented through a controlled pathwise problem and an SDE. A general cost functional is considered, and ε -optimal controls are derived via finite-dimensional Galerkin approximations and a linearization technique.

REFERENCES

- [1] W. Grecksch, H. Lisei, *Fractional Noise-Perturbed Nonlinear Schrödinger Equations: Stochastic Minimization Problems*, in: W. Grecksch, H. Lisei (eds.), *Fractional S(P)DEs: Theory, Numerics and Optimal Control*, World Scientific Publishing, Singapore (2025), pp. 105-150.

A BAYESIAN FRACTIONAL POSTERIOR APPROACH TO THE GAUSSIAN WHITE NOISE MODEL

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MSC: 62G20, 62C10

Keywords: fractional posteriors, Bayesian inference, Gaussian processes, contraction, uncertainty quantification

We study the performance of Bayesian procedures in the Gaussian white noise model, with the addition of using fractional posteriors. These generalised Bayesian posteriors are obtained by raising the likelihood to a power $\gamma > 0$.

We examine these procedures from a frequentist perspective, assuming that the data are generated by a fixed but unknown true parameter. The rates of contraction to the true parameter are shown to be influenced by the smoothness of the prior and the magnitude of the fractional exponent. We also study the asymptotic coverage of fractional posterior credible sets. If the fractional power diverges, even arbitrarily slowly, the coverage is asymptotically zero, while bounded or decreasing fractional powers can lead to conservative coverage when the prior is not oversmoothed. Correct combinations of the prior smoothness and the fractional power lead to almost optimal rates of contraction, while resulting in conservative posterior coverage. This phenomenon is illustrated through simulations.

FUNCTION APPROXIMATION USING NON-NEURAL AND NEURAL METHODS

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MSC: 41A30, 41A63, 41A44, 65D15, 65D20

Keywords: approximation theory, neural models, learning problem, trigonometric functions, multivariate polynomial, exponential functions, Power Nakagami distribution

This paper will focus on the approximation theory, based on the problem of approximating or interpolating a continuous Multivariate Function (MF) by an approximating function having a fixed number of parameters, that provides the best possible approximation of the respective function on the set of examples. From this point of view, the approximation of a function is equivalent with the learning problem for a Neural Network (NN). One of our research objective is to highlight many advantages of exploring the capabilities of the NNs to implement Function Approximation (FA). Based on this research program, we will develop a work started during my two postdoctoral stages (made at the Computer Science Department of the University of Amsterdam, Netherlands) that consists in using the Orthogonal NNs as universal approximators to continuous functions on compact domain.

VIABILITY PROBLEMS FOR SDEs IN A GENERAL GELFAND TRIPLE SETUP USING A VARIATIONAL APPROACH

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MSC: 60H15, 60H30, 47F05

Keywords: stochastic partial differential equations, Gelfand setup, viability conditions, variational contingent sets

We investigate some viability conditions for a general class of stochastic differential equations, studied in the variational approach:

$$dX_t = A(X_t) dt + B(X_t) dW_t.$$

The space setup that we consider is given by a general Gelfand triple $V \subset H \subset V^*$, where H is a separable Hilbert space, on which we should understand our equation. We provide necessary and sufficient characterization for the viability of closed random constraints in terms of adapted variational tangent or contingent sets. Several important classes of examples which can be considered are also envisaged.

NOTES ON MULTIDIMENSIONAL HARDY-TYPE INEQUALITIES VIA PROBABILITY THEORY

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MSC: 26D10, 60A10

Keywords: probabilistic proof, weighted Hardy inequality, density

The classical Hardy inequality has numerous different and interesting proofs. Motivated by recent probabilistic approaches, in this note we present a probabilistic proof of the multidimensional weighted Hardy inequality. The key ingredient of our method relies on the well-known information-theoretic fact that the Kullback-Leibler divergence is always non-negative.

By carefully choosing the density function, we first establish the following fundamental lemma:

$$\min_{\rho \in \mathcal{D}(Q_n)} \int_{Q_n} \frac{dx_1 \dots dx_n}{\rho(x_1, \dots, x_n)^{p-1} \prod_{j=1}^n x_j^{\alpha_j+1}} = \prod_{j=1}^n \left(\frac{p}{p - \alpha_j - 1} \right)^p,$$

where $p > 1$, $\alpha_j < p - 1$ for $j = 1, \dots, n$ and $\mathcal{D}(Q_n)$ is the family of all densities on the n -dimensional unit cube $Q_n = (0, 1)^n$ in $\mathbb{R}^n$. Using this lemma in conjunction with Fubini's theorem and Jensen's inequality, we provide the complete proof of the multidimensional weighted Hardy inequality. Furthermore, as an immediate consequence, we derive the multidimensional weighted Carleman inequality by passing to the limit as $p \rightarrow \infty$.

REFERENCES

- [1] M. Jovalekić, *A probabilistic proof of the multidimensional weighted Hardy inequality*, C. R. Acad. Bulg. Sci., 73 (2020), pp. 1483-1488.

ON THE INHOMOGENEOUS SINCOV-PEXIDER EQUATION

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MSC: 39B52, 39B82.

Keywords: functional equation, Ulam stability

We study the inhomogeneous Sincov-Pexider equation

$$f(x, z) - g(x, y) - h(y, z) = I(x, y, z),$$

where $f, g, h : S^2 \rightarrow G$ are the unknown functions, $I : S^3 \rightarrow G$ is a given function, S is a nonempty set, and $(G, +)$ is an Abelian group.

We establish necessary and sufficient conditions on the function I for the existence of a solution to the inhomogeneous Sincov-Pexider equation and we investigate its Ulam stability. These results provide a quantitative description of the relationship between approximate and exact solutions.

REFERENCES

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- [2] A. Măduța, D. Popa, A. Sîngeorzan, *On the inhomogeneous Sincov's equation*, Results Math ., **81** (2026), 90.
- [3] A. Măduța, D. Popa, A. Sîngeorzan, *Inhomogeneous Sincov-Pexider equation*, Acta Math. Hungarica.

ON A COUPLING APPROACH FOR PARTICLE FILTERS AND PINNS

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MSC: 60G35, 65C05

Keywords: particle filters, physics-informed machine learning

The aim of this presentation is to provide an overview of the current progress in coupling particle filters and physics-informed neural networks (PINNs). Often, PINNs estimate the solution of a system using observations of either the state itself or, when an unknown parameter is present, the forcing term or the boundary condition. We propose an approach that combines PINNs with particle filters, allowing for observations that are not necessarily direct measurements of the state.

REFERENCES

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- [2] L. Yang, X. Meng, G.E. Karniadakis, *B-PINNs: Bayesian physics-informed neural networks for forward and inverse PDE problems with noisy data*, Journal of Computational Physics, Volume 425 (2021), 109913.

STOCHASTIC PDEs WITH MEMORY-DEPENDENT NOISE

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MSC: 60H15

In the celebrated theorem proved independently by J. Feldman and J. Hájek, the dichotomic behaviour of Gaussian measures on locally convex spaces was established: Any two Gaussian measures are either mutually singular or equivalent (mutually absolutely continuous). While J. Hájek applied this theoretical result to probability laws of finite dimensional stochastic processes on their (infinite dimensional) path spaces for statistical purposes, it later turned out to be useful in other fields of mathematics. In this talk, we recall some applications of the FH theorem to the large-time behaviour of solutions to stochastic evolution equations. The conditions for equivalence of laws in the Markovian case (i.e., when the driving noise is white in time) are compared with those for temporally fractional noise (in particular, the fractional Brownian motion) and the dependence of this phenomenon on the Hurst parameter is studied. Finally, we discuss possible extensions beyond the Gaussian setting. It turns out that even for equations driven by the Rosenblatt process (i.e., for noise living in the second Wiener chaos) analogous results do not hold. This has interesting consequences, for example, for statistical inference for such models.

ON THE BEST ULAM CONSTANT OF A PARTIAL DIFFERENTIAL OPERATOR

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MSC: 39B82, 47A50, 47A63.

Keywords: Partial differential operator, Gauge, Best Ulam constant.

In this paper, we investigate the Ulam stability of the linear partial differential operator $D: C^1(\mathbb{R}^2, X) \rightarrow C(\mathbb{R}^2, X)$, defined by $Du = au_x + bu_y + cu$, where $a, b, c \in \mathbb{R}$ and X is a real Banach space. We provide a characterization of the Ulam stability of D and determine its best Ulam constant.

REFERENCES

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- [3] A. Novac, D. Otrocol, D. Popa, *On Ulam stability of a partial differential operator in Banach spaces*, Mathematics, 11 (2023), 2488.

GENERALIZED VORONOVSKAJA THEOREM FOR A CLASS OF MULTIDIMENSIONAL OPERATORS

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Let $(L_n)_n$, be a sequence of positive linear operators, defined on the space $C(K)$ where $K \subset \mathbb{R}^k$ is a compact set. Suppose that L_n preserves the affine functions. Denote by $\pi_i : \mathbb{R}^k \rightarrow \mathbb{R}$, $1 \leq i \leq k$ the canonical projections and by $m_{i,j}^n(\bar{x}) = (L_n(\pi_i - x_i 1)(\pi_j - x_j 1))(\bar{x})$, where $\bar{x} = (x_1, \dots, x_k) \in K$, for $1 \leq i, j \leq k$. Suppose that there exist the limits $\lim_{n \rightarrow \infty} m_{i,j}^n(\bar{x}) = \alpha_{i,j}(\bar{x})$, $\bar{x} \in K$. We show that with additional conditions for the higher-order moments the following result

$$\lim_{n \rightarrow \infty} n^s ((L_n - I)^s f)(\bar{x}) = \frac{1}{2} \left(\left(\sum_{i,j=1}^k \alpha_{i,j}(\bar{x}) \frac{\partial^2}{\partial x^i \partial x^j} \right)^s f \right) (\bar{x}),$$

$(f \in C^{2s}(K), s \in N, \bar{x} \in K)$ holds true. The main result is accompanied by examples.

ESTIMATIONS FOR THE ABSOLUTE CENTRAL MOMENTS OF SOME APPROXIMATION OPERATORS

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MSC: 41A10, 41A25

Keywords: Bernstein polynomials, linear positive operators, max-product operators, absolute central moments

For the famous Bernstein polynomials (B_n) one of the important problems is the one in which one tries to find an upper bound for the absolute central moments. In this contribution we provide new results for this problem which in some special cases improve the best global estimation known in the present.

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LAGRANGE-HERMITE TYPE QUINTIC SPLINE WITH CONVERGENCE PROPERTIES AND APPLICATIONS

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MSC: 41A05, 41A15, 65D05, 65D07

Keywords: polynomial spline, Lagrange–Hermite interpolation,
Peano kernel theorem, error bound

We introduce a quintic Lagrange–Hermite spline interpolating f at the nodes of a partition of $[0, 1]$ and at two interior points per subinterval, and with f' prescribed at the end-points, extending to degree five the deficient quartic spline of Howell and Varma [1] and its type II variant due to Bica and Curilă [2]. We prove the existence and uniqueness of the resulting global C^2 smooth spline and, via the Peano kernel theorem, we obtain an error bound of order $O(h^6)$ for $f \in C^6[0, 1]$.

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ON THE JORDAN–VON NEUMANN OPERATOR ON ABELIAN GROUPS

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MSC: 39B52, 39B22, 20J06

Keywords: quadratic functional equation, inverse problem, abelian group

Let G be an abelian group and X a real Banach space. The Jordan–von Neumann operator

$$Q[f](x, y) = f(x + y) + f(x - y) - 2f(x) - 2f(y)$$

has the quadratic mappings $f: G \rightarrow X$ as its kernel. We discuss its image: three algebraic conditions on $g: G \times G \rightarrow X$ are necessary for solving $Q[f] = g$, namely a cocycle identity, quasi-symmetry and a rotation identity. On torsion-free groups of rational rank one the cocycle identity alone characterises the image, by an explicit recursion. Under growth conditions two dyadic series invert Q , one of them strengthening [2], and within each growth regime the corresponding condition characterises the image; both constructions complement the integral formula of [1].

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BIVARIATE BERNSTEIN FRACTAL INTERPOLATION METHOD

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MSC: 65D05, 28A80

Keywords: fractals, interpolation, iterated function system

Fractal interpolation functions provide new methods for the approximation of experimental data. The main advantage of them is that the classical methods of real data interpolation can be generalized with fractal interpolation. Also, these methods can be generalized in multivariate case, too. Using a twodimensional interpolation formula and the bivariate Bernstein polynomials we construct the bivariate Bernstein-type fractal interpolation formula. We prove that the approximation properties still apply, and we also give a delimitation of the error.

RANDOM AND ABSTRACT ELLIPTIC VARIATIONAL EQUATIONS

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MSC: 35R60, 35J20, 60B11

Keywords: random differential equation, elliptic variational equation, measurability of Banach space-valued mappings

In the theory of deterministic elliptic partial differential equations abstract elliptic variational equations are widely used. It is the hope that in the investigation of elliptic partial differential equations with random parameters also similar variational equations can be used. In the talk the usage of abstract elliptic variational equations for corresponding random problems is investigated. Hereby different measurability conditions play an important role.

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GAUSS-TYPE QUADRATURES WITH FIXED WEIGHTS ASSOCIATED WITH PRESCRIBED NODES

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MSC: 65D30, 65D32

Keywords: Gauss quadrature, Christoffel quadrature, prescribed nodes, fixed weights

Among interpolatory quadratures with m prescribed and n free nodes, the maximum algebraic degree of exactness is $2n - 1 + m$. If the integrand vanishes at prescribed nodes, the corresponding weights need not be computed. However, for a general integrand, this property does not hold. We propose a decomposition of the integrand into two parts. The first part can be integrated exactly and its integral is represented by a finite sum involving fixed weights associated with the prescribed nodes, eliminating the need to recompute these weights when the number of free nodes changes. The second part vanishes at all prescribed nodes, enabling the construction of a quadrature with only n free nodes that is exact for all polynomials of degree at most $2n - 1 + m$ having the m prescribed nodes as zeros. The resulting quadrature has all nodes pairwise distinct and in the open integration interval, all weights positive, and converges. The results are supported by numerical examples.

STOCHASTIC OPTIMAL CONTROL OF HEATING SYSTEMS WITH A GEOTHERMAL ENERGY STORAGE

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MSC: 93E20, 90C40

Keywords: stochastic optimal control, Markov decision process, model order reduction

We investigate a stochastic optimal control problem for the cost-optimal control of a residential heating system with renewable and non-renewable heat generation, various consumption units, and a geothermal storage system that enables the intertemporal transfer of thermal energy by storing excess heat for later use. In addition, we account for uncertainties regarding the randomly fluctuating heat generation from renewable energy sources as well as the environmental conditions that determine heat demand and supply. The dynamics of the multidimensional controlled state processes is governed by a PDE, a random ODE and two SDEs. We first apply a spatial discretization to the PDE and use model order reduction techniques to reduce the dimension of the associated system of ODEs. Finally, a time-discretization leads to a Markov decision process for which we determine approximations of the cost-optimal control and the associated value function.

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