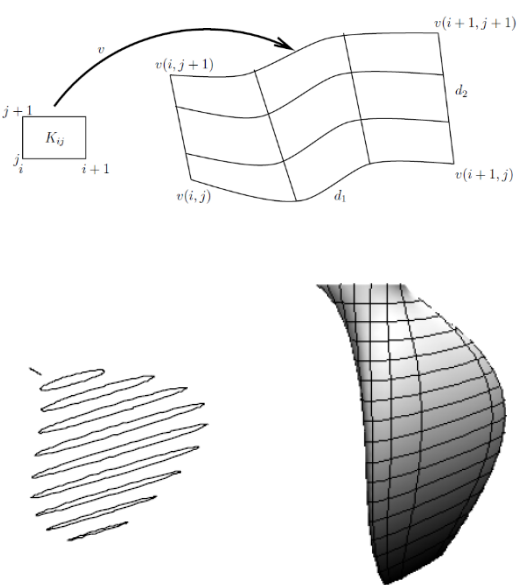
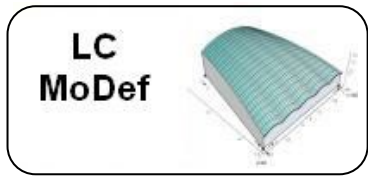


APPROXIMATION METHODS AND CALCULUS OF VARIATIONS IN DEFFORMABLE MODELS APPLIED IN IMAGE PROCESSING AND COMPUTER ASSISTED MEDICINE - RESEARCH LABORATORY

Contact details

Name	Approximation methods and Calculus of Variations in Deformable Models applied in Image Processing and Computer Assisted Medicine – Research Laboratory	
Acronym	LC MoDef	
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Areas of expertise

LC MoDef research laboratory is devoted to the development of the mathematical basis of the theory of deformable models and to the applications of this theory in image processing and medical imaging, involving the following areas of expertise:

- Differential Equations
- Calculus of Variations
- Geometry
- Numerical Analysis
- Probabilities
- Modelling & Simulation
- Laplace Transform
- Medical Imaging (Ultrasonography, CT, MRI)
- Digitization based on mathematical models applied in the medical field

Team

Prof. Dr. Math. Alexandru Mitrea; Prof. Dr. Math. Dumitru Mircea Ivan; Assoc. Prof. Dr. Math. Daniela Inoan Prof. Dr. Math. Radu Peter; Assoc. Prof. Dr. Math. Daniela Marian; Lect. Dr. Math. Mircia Gurzau; Lect. Dr. Math. Delia Kerekes

Representative projects

MoDef, “Modelling using advanced methods and techniques based on the theory of deformable surfaces with applications in computer assisted surgery and other modelling procedures of anatomic structures”, PN II 11018-Partnership, <http://dicomge.utcluj.ro/modef> (2007-2010)

Advanced Methods and Algorithms of Mathematics related to the Theory of Deformable Models, with applications in image processing and medicine, Grant CNCSIS 1255, 2006-2008

Significant results

The most representative publications of the past 5 years:

1. Inoan, D., Aadi, S.B., Akhlil, K.. Equilibrium problems with trifunctions and applications to hemivariational inequalities. Anal.Math.Phys. 15, 125 (2025). <https://doi.org/10.1007/s13324-025-01123-0>
- 2.. Inoan, D., Marian, D. Semi-Hyers–Ulam–Rassias Stability for an Integro-Differential equation of order n . Demonstratio Mathematica (2023), vol.56 (1), pp.2022019, <https://doi.org/10.1515/dema-2022-0198>

3. . Marian D, , Akinola, R.O., Ali Shokri, Joshua Sunday, Oyindamola D. A. *Comparing the Performance of Two Butcher-Based Block Hybrid Algorithms for the Solution of Initial Value Problems* Axioms 13, no. 3: 165 (2024), <https://doi.org/10.3390/axioms13030165>
4. Inoan, D., Marian, D. *Semi-Hyers–Ulam–Rassias Stability of Some Volterra Integro-Differential Equations via Laplace Transform*. Axioms (2023), 12, 279. doi.org/10.3390/axioms12030279
5. Marian, D., Ciplea, S. A. , LunguN., *Hyers-Ulam stability of a nonlinear partial integro-differential equation of order three*, Open Mathematics, vol. 22, no. 1, 2024, pp. 20240017. <https://doi.org/10.1515/math-2024-0017>
6. Kerekes, D.M., Mosnegutu, B., Popa, D., *On Ulam stability of a second order linear difference equation*. AIMS Mathematics 8 (9), 20254-20269, (2023)
7. Kerekes,D.M., Baías, A.R., *Some results concerning chain rules for Dini-Hadamard constructions* Positivity 26 (3), 52, (2022)
8. Inoan, D., Marian, D. *Semi-Hyers–Ulam–Rassias Stability via Laplace Transform, for an Integro-Differential Equation of the Second Order*. Mathematics 2022, 10, 1893. <https://doi.org/10.3390/math10111893>
9. Inoan, D., Kolumbán, J. *Calmness of the Solution Mapping of Navier-Stokes Problems Modeled by Hemivariational Inequalities*. Set-Valued Var. Anal 30,1089–1104 (2022).<https://doi.org/10.1007/s11228-022-00636-1>
10. Mitrea, A.I. *Remarks on using some Finite Difference Schemes to provide energy minimizing snakes*, The 17-th International Conference on Applied Mathematics and Computer Science, July 11-14, 2023
111. D. Marian, S. A. Ciplea, N. Lungu, *Hyers–Ulam Stability of a System of Hyperbolic Partial Differential Equations* Mathematics 2022, 10(13), 2183; <https://doi.org/10.3390/math10132183>
12. Marian, D.; Ciplea, S.A.; Lungu, N. *Hyers–Ulam Stability of Order k for Euler Equation and Euler–Poisson Equation in the Calculus of Variations*. Mathematics 2022, 10(15),2556. <https://doi.org/10.3390/math10152556>2556. <https://doi.org/10.3390/math10152556>
13. Sunday, J.; Shokri, A.; Marian, D. *Variable Step Hybrid Block Method for the Approximation of Kepler Problem*. Fractal Fract. 2022, 6(7), 343. <https://doi.org/10.3390/fractalfract6060343>
14. Juraev, D.A.; Shokri, A.; Marian, D. *On an Approximate Solution of the Cauchy Problem for Systems of Equations of Elliptic Type of the First Order*. Entropy 2022, 24, 968. <https://doi.org/10.3390/e24070968>
15. Ivan, M. Neagos, V. *A representation of the interpolation polynomial*, Numerical Algorithms 88 (2021), 1215—1231, <https://doi.org/10.1007/s11075-021-01072-2>
16. Inoan, D. *Calmness of the Solution Mapping of Parametric Variational Relation Problems*, Filomat, Vol. 35 (2021), No. 10, 3541–3548, <https://doi.org/10.2298/FIL2110541I>
17. Inoan, D., Marian, D. *Semi-Hyers–Ulam–Rassias Stability of a Volterra Integro-Differential Equation of Order l with a Convolution Type Kernel via Laplace Transform*, Symmetry, Vol 13, Issue 11, 2181. <https://doi.org/10.3390/sym13112181>, 2021
18. D. Marian, *Semi-Hyers–Ulam–Rassias Stability of the Convection Partial Differential Equation via Laplace Transform*. Mathematics. 2021; 9(22):2980. <https://doi.org/10.3390/math9222980>
- 19..D. Marian, *Laplace Transform and Semi-Hyers–Ulam–Rassias Stability of Some Delay Differential Equations*. Mathematics. 2021; 9(24):3260. <https://doi.org/10.3390/math9243260D>
20. Peter, Ioan Radu, *A Bound of the Finslerian Ricci Scalar* MEDITERRANEAN JOURNAL OF MATHEMATICS Volume: 15 Issue: 3 Article Number: 143 (2019)

Significant solutions:

Considering until now parametric (variational) deformable models, we developed an iterative method based on finite difference schemes in order to solve numerically the ELP equation of Calculus of Variations, which provides the energy minimizing snake; we derived estimates concerning the approximation error related to the corresponding ELP algorithm and we established conditions for its convergence and stability; as future targets, we intend to consider probabilistic models which offer an alternative approach by using the Bayes technique, as well as geometric deformable models which provide an efficient alternative to address some limitation of parametric deformable models. Also, we study semi-Hyers–Ulam–Rassias stability of some integro-differential equations via Laplace transform.

Products and technologies:

1. Mathematical study concerning the deformable model theory: energy functional, evolution equation, discretization methods
2. Stochastic Modelling and Simulation Platform/Implemented in Java/
3. 3D Deformable Surfaces Modelling Software Environment
4. Mathematical study regarding the stability of some differential equations using Laplace Transform.

The offer addressed to the economic environment

Research & development	Generating performing mathematical algorithms in o by means of Laplace Transformrder to obtain the minimizing-energy curves and surfaces. Finding approximation error, convergence rate and giving consistency and stability conditions concerning these algorithms .
Consulting	Consulting in finding suitable algorithms to obtain minimizing-energy curves and surfaces, which assist activities in medicine, industrial environments, modern traffic infrastructure, physics

Training	Deformable models theory: reveal of the interdisciplinary value of the domain, connections with practical problems of medicine, image processing, and physics; knowledge confluence from functional analysis, approximation theory, differential equations, differential geometry, calculus of variations, numerical analysis, linear algebra, Laplace transform, and probability theory. Model-based approach: integrating computer-assisted medical image analysis, their applications at this level including image segmentation, shape representation and motion tracking.
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