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RA3: Convex relaxations for non-convex problems in materials and industrial design

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Robotics and Advanced Industrial Production
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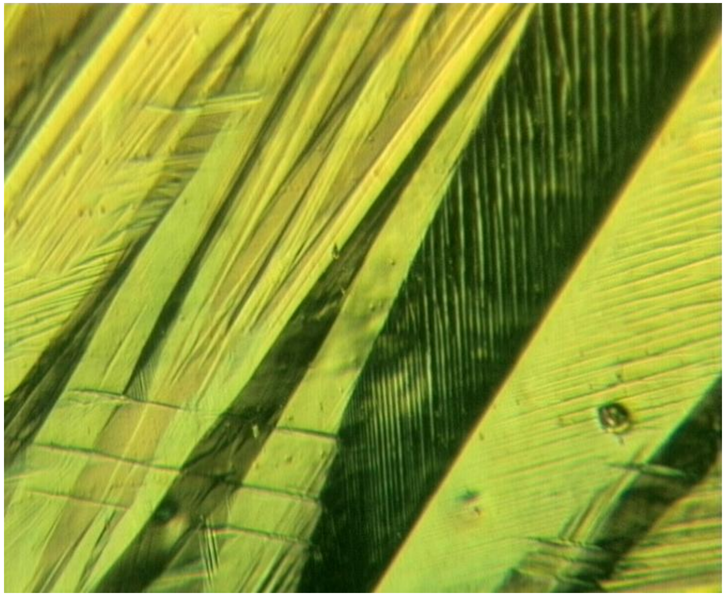
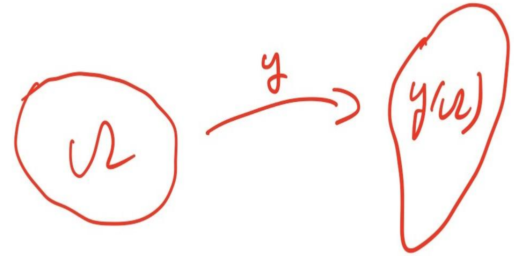
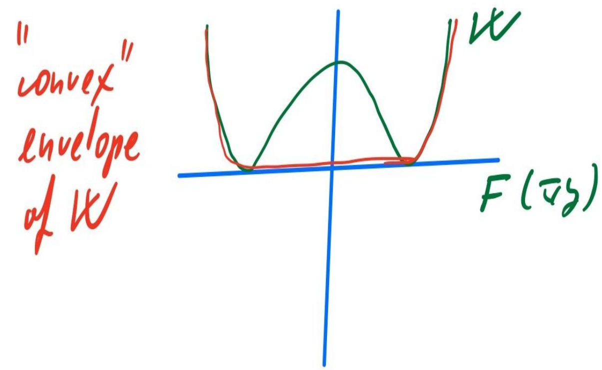
Materials-Science Problem



CuAlNI shape memory alloy, IoP CAS



$$\min_{y} I(y) = \int_{\Omega} W(\nabla y(x))\, dx + BC$$



RA3: Convex relaxations for non-convex problems in materials and industrial design

RO 3.1: No relaxation gap in moment-sums-of-squares (SOS) hierarchy

Milestone 3.1.1: proof of non-relaxation gap for polynomial calculus of variations (COV) with convexity (micromagnetics)

Milestone 3.1.2: proof of non-relaxation gap for polynomial partial differential equations (PDE) from materials (multiwell problems in materials science, multiwell problems, shape memory alloys)

RO 3.2: Better scalability in moment-SOS hierarchy

Milestone 3.2.1: computational evidence of better scalability on benchmark problems with symmetry and sparsity

Milestone 3.2.2: new kind of sparsity (beyond correlative and term sparsity) for materials and industrial design

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G3 Team members

G3 members:

Prof. Didier Henrion (leader)

Dr. Milan Korda

Prof. Martin Kružík

Prof. Jean-Bernard Lasserre

Dr. Jakub Mareček

2 PhD students
2 post-docs

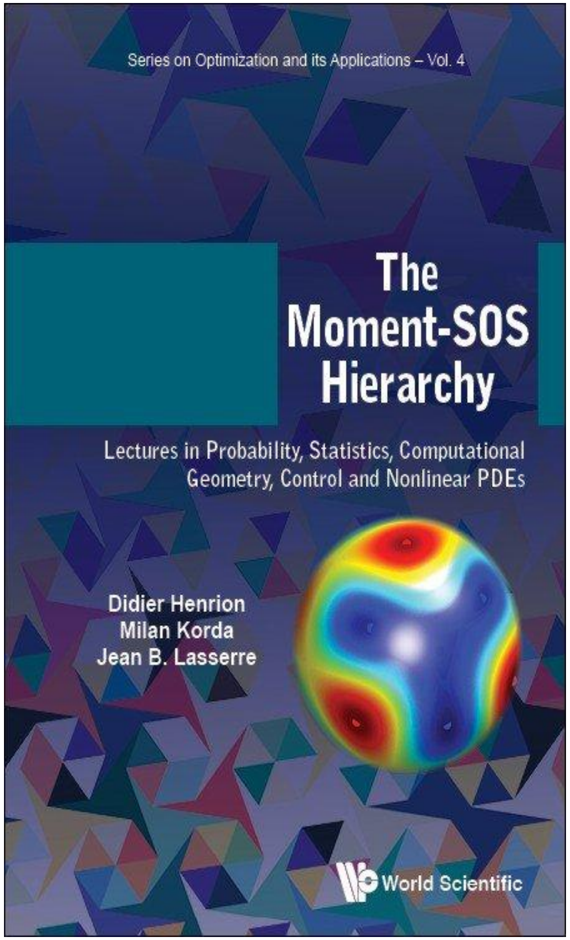
Moment SOS Hierarchy

Reformulation of non-convex problems (optimization, optimal control, COV, PDE) as infinite-dimensional linear problems on probability measures

Approximation by convex optimization (typically semidefinite optimization) problems of increasing finite dimension

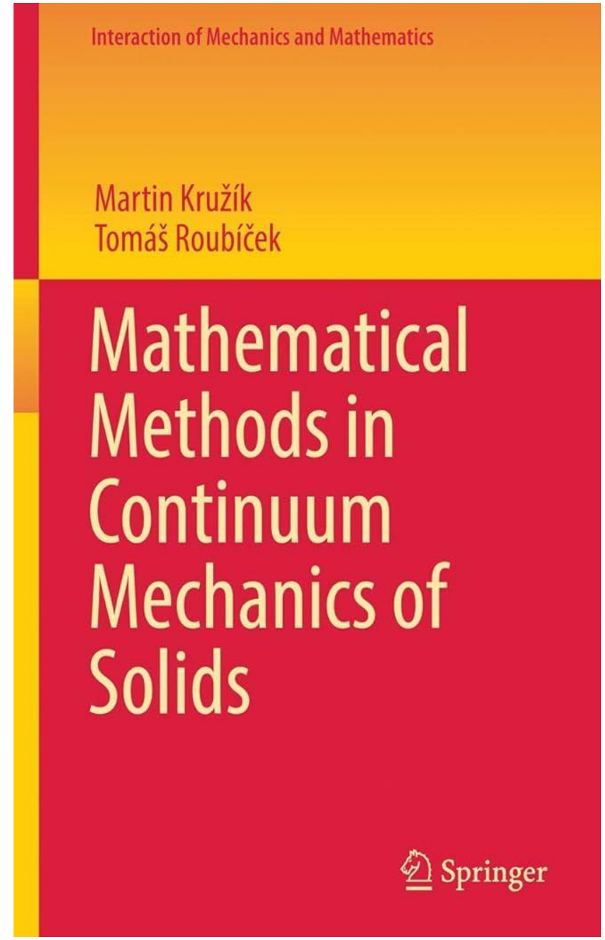
Convergence guarantees based on convex duality between moments (probability theory, functional analysis) and positive polynomials expressed as sums of squares (real algebraic geometry)

Originally proposed for polynomial optimization by Lasserre (2000) and then broadly extended ...



Poema

Polynomial Optimization, Efficiency through Moments and Algebra



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Thank you for your attention!

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VSB TECHNICAL UNIVERSITY OF OSTRAVA

UNIVERSITY OF WEST BOHEMIA

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