



FP7-PEOPLE-2009-IRSES:
Project ID 246647

Optimization and its Applications
in Learning and Industry
(OptALI)

IRSES

Ongoing Deliverable D1.2

Description of Research Seminars

Start date of the Workpackage: December 2010

Duration: 60 months

Due date of deliverable: December 2015

Actual submission date: December 2015

Participants: UGOE
UNIKL
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Research Seminar

offered by Sönke Behrends (University of Göttingen)

in March 2015,

in Auckland, New Zealand

Subject: Unconstrained polynomial integer minimization

Problem: Suppose you are given a polynomial in several variables, how do you find its minimum value over the integers? By a famous result from Matiyasevich, this problem cannot be solved in full generality. We thus consider polynomials with special properties to make the problem solvable.

Main Results: Such a tractable case is present if the leading form of the polynomial - given by its highest order terms - attains positive values only (except at 0). In this case, the leading form is called positive definite, and this can be decided by computing the minimum of the leading form on a suitable sphere. Once positive definiteness is decided, we can compute the radius of a ball that must contain all optimal integer solutions. From a conceptual point of view, we infer geometric properties of the optimal solution before we compute it (but in this talk we do not pursue this further). We could now simply enumerate all solutions and compare their function values to find the optimal ones. However, this soon gets prohibitive for more than a few variables or a large radius. A technique known in the literature as branch and bound in conjunction with tight lower bounds can help to speed up the solution process. To this end, we present a new class of lower bounds and some results on random instances. In this talk we also address the computational techniques involved as well as the corresponding software implementations.

This is joint work with Ruth Hübner and Anita Schöbel.

Participants: Researchers and students from the University Auckland and researchers from the Universities of Copenhagen, Kaiserslautern and Göttingen.

Publication: -