Stieltjesprijs academic year 2022-2023 : Report of the jury

This report gives the summary of the selection process of the jury of the Stieltjesprijs for the best thesis in Mathematics in the academic year 2022-2023. The jury consisted of Erik van den Ban (UU), Odo Diekmann (UU), Aernout van Enter (RUG), Frans Oort (UU), Marc Uetz (UT), Aad van der Vaart (TUD) and Kees Vuik (TUD, chair), with assistance from Marieke Kranenburg (UvA, secretary). A total of 76 dissertations were assessed. External advice was obtained at various stages of the assessment. After an initial selection, a shortlist of 8 dissertations was compiled. On Wednesday 13 December, 2023 the jury met to discuss the shortlist and to choose a winner.

The quality of the 8 dissertations on the shortlist was again very high. After the first round of discussion, 3 dissertations remained, all of them of impressive quality, great originality and extremely well written. After an extensive second round of discussion, the jury concluded that there were no clear distinguishing elements on which a winner could be identified. Ultimately, the jury decided to hold a voting round, from which the winner was chosen. The jury nominates Lucas Slot (UvT) for the Stieltjesprijs 2022-2023 for his thesis entitled “Asymptotic Analysis of Semidefinite Bounds for Polynomial Optimization and Independent Sets in Geometric Hypergraphs”.

The dissertation of Lucas Slot consists of three parts. The first two parts deal with the performance analysis of hierarchies of semidefinite approximations for polynomial optimization problems. These nonlinear nonconvex optimization problems are hard to analyze and are used in many applications. These Lasserre hierarchies provide upper bounds (Part 1) and lower bounds (Part 2) for the global optimum. For the upper bounds the thesis offers an essentially optimal analysis for polynomial optimization problems over convex bodies and general compact semi-algebraic sets and a tight analysis for special sets including the box, the simplex, the ball and general convex bodies with a nice boundary. These results represent the state-of-the-art. They show an explicit performance analysis with quadratic dependence in the degree, which gives a strong improvement on the best known results in literature. The third part of the thesis is devoted to bounding the size of simplex-avoiding sets in geometric hypergraphs via a recursive theta-number, extending in a very nice way ideas that are classical in the case of graphs.

The thesis is based on 7 papers most of them already published in high ranked journals. Finally the jury noted that the thesis was written in only 3,5 years. We see this as an excellent thesis which fully deserves the Stieltjesprijs.