The **Vienna School of Mathematics (VSM)** is a joint graduate school of the mathematics faculties of the **University of Vienna** and the **TU Wien**. The VSM is devoted to top-level PhD education in all branches of mathematics. It fosters intra- and interdisciplinary scientific cooperation and networking among students and advisors and aims at increasing the international visibility of the Vienna area as a center for mathematics.

The VSM currently announces a PhD position in the project

NoMASP: Nonsmooth Nonconvex Optimization Methods for Acoustic Signal Processing
(Austrian Academy of Sciences, Supervisor: P. Balazs; University of Vienna, Supervisor: R. Boţ)

The most important problems of current interest in the field of acoustic signal processing include the following: compressed sensing – a technique that aims to reconstruct a signal from only a few measurements; audio denoise - removing noise or other disturbances from a signal; audio inpainting – restoring and recovering missing portions in audio signals; system identification –estimating the transformation system from the output signal ; and phase retrieval –to recover a signal from its magnitudes only.

These problems share the feature that they can be modelled and formulated as structured nonsmooth nonconvex optimization problems, which means that, in order to solve them, one usually has to minimize a function which in many cases has a complicated expression and it is neither convex nor differentiable. In other words, the function to be minimized has usually not a global minimum, but many local minima and maxima, and it fails to be differentiable, in particular at these local extrema. In practice many approaches apply ad-hoc, smooth or convex methods, ignoring that they are certainly not perfectly fitted, but still reaching successful solutions. In this project we aim at a more holistic approach marrying mathematics and applications. The main aim of this research project is to design numerical algorithms for solving such structured nonsmooth nonconvex optimization problems without heuristic simplifications. The proposed algorithms will be analyzed from the point of view of their convergence properties, accuracy and stability. The applications to audio signal processing problems will help to validate the theoretically founded convergence behavior of the new algorithms, and also provide new understanding and novel approaches for important tasks in acoustics, like the ones mentioned above.

The theoretical goals are at the cutting edge of current mathematical research, therefore their application in signal processing will be extremely innovative. The goal of this application-oriented mathematics project is not only to apply completely novel mathematical results to certain tasks, but also learn from those applications new concepts and properties that are interesting from a purely mathematical point of view.

The Ph.D. project will be concerned with connecting the mathematical theory with the application in acoustical signal processing. The first tasks will be to explain the exceptional convergence behaviour of the Fast Griffin-Lim, and improve the ADMM method in audio inpainting methods. The concrete thesis project will be developed jointly with the successful applicant.

The basic requirement for the position is a good knowledge in signal processing and optimization.

The advertised position is associated with the Faculty of Mathematics of the **University of Vienna** in the Research Group on Applied Mathematics with Emphasis on Optimization of Prof. Radu Boţ and the **Austrian Academy of Sciences** in the Acoustics Research Institute (director: Peter Balazs). The successful candidate is expected to pursue a doctoral study in Mathematics at the University of Vienna, to become a member of the Vienna School of Mathematics and to actively contribute to its activities. The extent of employment is 30 hours per week for a duration of 4 years. The annual gross salary is EUR 31.326,40 (before taxes, 14 payments a year) according to the FWF salaries 2021. The position will start on January 1, 2022.

Application Requirements and Procedure

The candidates must have a master degree (or equivalent) in Mathematics at the moment the PhD position starts. The application documents should contain a letter of motivation; the scientific CV with publications list; higher education certificates/diplomas; and letter(s) of recommendation preferably sent directly to office@vsmath.at by the person writing the letter. Applications have to be sent to office@vsmath.at, if possible in a single PDF file. The deadline for applications is **December 6, 2021.**

The Austrian Academy of Sciences and the University of Vienna value diversity and are committed to equality of opportunity.