PhD-Project title: Multivariate Subdivison Schemes and PDE-Methods in Image Processing and Geometric Modeling

Principal Investigator: Dr. Hermann Render

This PhD-project focuses on new mathematical techniques in the area of image processing and geometric modeling and their applications. The approach depends on a new data concept in these areas which is motivated by techniques for solving boundary value problems for elliptic operators in PDE, see e.g. [6].

The main aim is the analysis of new multivariate subdivision schemes and applications to image processing which has been investigated by our research group for special cases, see [2,3]. These subdivision schemes are based on polyharmonic interpolation on parallel hyperplanes, or in a second modeling, on concentric spheres.

The applicant may profit from a cooperation of the principal investigator with leading experts in Subdivision Schemes and Geometric Modeling (Prof. N. Dyn and Prof. D. Levin (University of Tel Aviv, Israel) and Prof. O. Kounchev (Bulgarian Academy of Sciences).

Required knowledge: Solid background in Real and Complex Analysis, Functional Analysis and Partial Differential Equations. Basic knowledge in wavelet analysis will be helpful.

For first reading we recommend:

1. I. Daubechies, *Ten lectures on wavelets*, SIAM, Philadelphia 1992.
2. N. Dyn, O. Kounchev, D. Levin, H. Render, *Non-stationary Daubechies type wavelets for exponential polynomials and their regularity,* Applied Comp. Harm. Analysis 37 (2014), pp.288-306
3. N. Dyn, O. Kounchev, D. Levin, H. Render, *Polyharmonic interpolation and subdivision schemes,* in progress.
4. N. Dyn, D. Levin, A. Luzzatto, *Exponentials reproducing subdivision scheme*, Found. Comput. Math. 3 (2003), 187–206.
5. N. Dyn, D. Levin, *Subdivision schemes in geometric modelling*, Acta Numerica (2002). pp. 73 − 144.
6. O. Kounchev, *Multivariate polysplines: Applications to Numerical and Wavelet Analysis,* Academic Press, San Diego-London, 2001.
7. O. Kounchev, H. Render, T. Tsachev, *On a class of L-splines of order 4: fast algorithms for interpolation and smoothing.* BIT 60 (2020), no. 4, 879–899.
8. O. Kounchev, H. Render, *Interpolation of data functions on parallel hyperplanes.* J. Approx. Theory 246 (2019), 43–61.