



# Einladung zum Oberseminar Wissenschaftliches Rechnen

Julius-Maximilians-Universität Würzburg  
Lehrstuhl für Wissenschaftliches Rechnen IX

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## Theory of Function Spaces: On Classical Tools for Modern Spaces

In the first part of this talk, we discuss basic principles of the theory of function spaces. In particular, we briefly recall the Fourier analytical approach towards classical smoothness spaces of distributions and point out their importance in the areas of approximation theory and the regularity theory of PDEs.

The main part of the talk is devoted to so-called Triebel-Lizorkin-Morrey spaces  $\mathcal{E}_{u,p,q}^s$  of positive smoothness  $s$  which attracted some attention in the last 15 years. This family of function spaces generalizes the by now well-established scale of Triebel-Lizorkin spaces  $F_{p,q}^s$  which particularly contains the usual  $L_p$ -Sobolev spaces  $H_p^s = F_{p,2}^s$  as special cases. Moreover, there are strong relations to standard classes of functions like BMO and Campanato spaces which are widely used in the analysis of PDEs. We will present new characterizations of Triebel-Lizorkin-Morrey spaces in terms of classical tools such as local oscillations (i.e., local polynomial bestapproximations) as well as ball means of higher order differences. Hence, under standard assumptions on the parameters involved, we extend assertions due to Triebel 1992 and Yuan/Sickel/Yang 2010 for spaces  $\mathcal{E}_{u,p,q}^s$  on  $\mathbb{R}^d$  and additionally consider their restrictions to (bounded) Lipschitz domains  $\Omega \subseteq \mathbb{R}^d$ . If time permits, we moreover indicate possible applications to the regularity theory of quasi-linear elliptic PDEs. The results to be presented are based on a recent preprint [1] in joint work with Marc Hovemann (Marburg).

[1] M. Hovemann and M. Weimar. Oscillations and differences in Triebel-Lizorkin-Morrey spaces. Submitted preprint (arXiv:2306.15239), 2023.

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Zu diesem Vortrag laden wir Sie herzlich ein.  
You are cordially invited to this lecture.

*gez. Prof. Dr. Alfio Borzi*  
*gez. Prof. Dr. Frank Werner*