Oberseminar Nichtlineare Differentialgleichungen

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Modulation Theory for Fully Localised Planar Patterns

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Abstract: Spatially localised patterns are known to emerge in a variety of physical settings, ranging from dryland vegetation to vibrating fluids to the buckling of cylinders. While there are a number of mathematical tools for studying localised patterns in one spatial dimension, developing equivalent approaches in higher spatial dimensions remains a major challenge in the area of pattern formation. In this talk, we will focus on 2D patterns that are localised in the radial direction and present a novel formal approach to derive radial amplitude equations [D.J. Hill & D.J.B. Lloyd, SIAM J. Appl. Math. (2024)], which provides new insight into the emergence of fully localised planar patterns. As an example, we formally derive radial amplitude equations for fully localised hexagons and quasipatterns in the Swift-Hohenberg equation (SHE), for which we can obtain explicit localised solutions. We then present current work on an existence proof for fully localised stripes in the SHE, using modulation theory from water waves (e.g. see [B. Buffoni, M.D. Groves & E. Wahlen, J. Math. Fluid Mech. (2022)]) extended to polar coordinates. To the authors' knowledge, this would provide the first existence proof of radially-localised non-axisymmetric planar patterns. This work is in collaboration with Mark Groves (Universität des Saarlandes).

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