A U S H A N G

FREIE UNIVERSITÄT BERLIN

Fachbereich Mathematik und Informatik

Promotionsbüro, Arnimallee 14, 14195 Berlin

D I S P U T A T I O N

Donnerstag, 16. Juni 2022, 14:00 Uhr

Ort: Seminarraum 126

(Fachbereich Mathematik und Informatik, Arnimallee 6, 14195 Berlin)

Disputation über die Doktorarbeit von

Herrn Vyacheslav Boyko

Thema der Dissertation:

Data-driven modeling of intermittent turbulence in the stably stratified atmospheric boundary layer

Thema der Disputation:

A method for circulation-based topological decomposition of fluid-dynamical data

Die Arbeit wurde unter der Betreuung von **Prof. Dr. N. Vercauteren** durchgeführt.

Abstract: The dynamic motion of fluid flows often exhibits characteristic flow patterns which are commonly referred to as vortices. Over the years, researchers have proposed numerous definitions for a vortex in three dimensions although none reached a consensus. In the field of flow visualization, there is a wide range of methods to study and classify flow structures. In this talk, I will present a methodology that addresses flow analysis by formulating and solving an inverse problem. The idea is to classify the two-dimensional vortex vector field in terms of closed and smooth circulation paths. We will specifically look for a classification function that maximizes the total cluster-averaged circulation over all subsets. The data is constrained to a discrete 2D plane containing a snapshot of a 3D velocity vector field. I will show how to construct an inverse problem by applying Stokes' theorem in combination with 2D variational regularization. The solution to the inverse problem provides a threshold-free segmentation of vector-valued structures that can be interpreted as vortex structures through the definition of the Stokes theorem. The method is able to identify pairwise related structures whose relationships are given by their direction of rotation. Adding the circulation values of pairwise opposite structures gives a zero. This result stimulates considerations about the topological properties of the structures found. The performance of the method is demonstrated on numerous flows with steadily increasing complexity: time-independent double vortex, Bickley jet, and a velocity vector field of a direct numerical simulation of a turbulent channel flow.

Die Disputation besteht aus dem o. g. Vortrag, danach der Vorstellung der Dissertation einschließlich jeweils anschließenden Aussprachen.

Interessierte werden hiermit herzlich eingeladen

Die Vorsitzende der Promotionskommission
Prof. Dr. N. Vercauteren