Data Mining Approaches to Understand Tensor Properties in Turbulent Cascade

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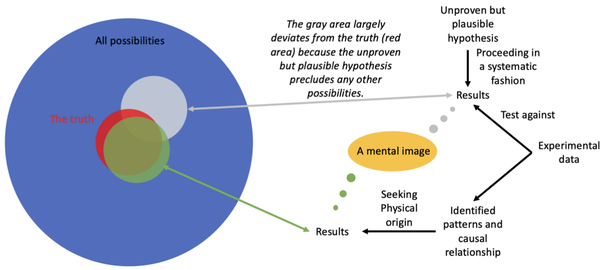
Motivation

- We are going to use data mining approaches (clustering algorithm, decision tree algorithm, and Apriori algorithm) to mine turbulent datasets to understand tensor properties of turbulence.

Project Description

- We are going to use clustering algorithm, decision tree algorithm, and Apriori algorithm to understand tensor geometry of turbulence, in which we will focus on three well-defined questions.
- The three well-defined questions are:
  - Understand the weak, yet persistent, asymmetry in energy flux.
  - Understand the “self-competition” in turbulent flows.
  - Understand properties of the turbulent stress and rate of strain.

Context



The proposed data mining approach for studying turbulence reverses the traditional approach to turbulence. Traditional turbulent studies start from an unproven but plausible and proceeds in a systematic to reach a result Our approach starts with turbulent data, which reveals the true physics of the turbulence. Using data mining techniques, we will find the patterns and causal relationships. From that, the physical origin is thought, which leads to new understandings of the turbulent flows.

University of Pittsburgh

Primary project goal: using **data mining** approaches to gain a deeper understanding of the **tensor properties** in 2D turbulence.

Project Deliverables

- By the end of the 1-year funding period, we will produce 1 peer-reviewed paper, 1 presentation at the American Physical Society Division of Fluid Dynamics.
- Pitt Momentum funding will enable our lab to get essential data to apply for an NSF standard grant.
- We will spend first 6 months gaining the data. Then, the next 6 months to analyze the data using data mining approaches

Potential Impact

- The success of this work could potentially result in a paradigm shift in turbulence research.
- The proposed research can find more constraints in turbulence for better turbulent modeling

References and/or Acknowledgements

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