Angelo Iollo

====

Introduction to Model Reduction and Projection-Based Techniques

Class 1: Introduction to Model Reduction (1 hour)

- Overview of Model Reduction: Understanding the need and significance of model reduction in engineering and scientific simulations.
- Advantages and Applications: Exploring real-world applications and benefits of model reduction techniques.
- Classification of Model Reduction Techniques: Overview of various model reduction approaches, including projection-based techniques.
- Challenges and Limitations: Discussing potential challenges and limitations of model reduction in different contexts.

Class 2: Projection-Based Model Reduction 1 (1 hour)

- Projection-Based Approaches: Introduction to projection-based model reduction methods, focusing on the reduction of high-dimensional systems.
- Proper Orthogonal Decomposition (POD): Exploring the POD technique for constructing low-dimensional subspaces.
- Galerkin Projection: Understanding the concept of Galerkin projection and its role in model reduction.

Class 3: Projection-Based Model Reduction 2 (1 hour)

- Empirical quadratures.
- Case Study: Presenting practical examples where empirical quadrature techniques are used for efficient model reduction.
- Hands-On Session: Guided practice in implementing a simple projection-based model reduction using POD.

Class 4: Projection-Based Model Reduction with Empirical Quadratures (1 hour)

- Integrating Empirical Quadratures: Extending projection-based techniques with empirical quadrature methods for enhanced efficiency.
- Combining Approaches: How to integrate empirical quadratures within projection-based model reduction frameworks.
- Numerical Examples: Solving real-world problems using combined techniques to demonstrate the advantages.

Class 5: Nonlinear Interpolations and Mappings (1 hour)

- Nonlinear Interpolation and optimal transportation.

- Mapping Functions.
- Error Analysis and Trade-offs: Understanding the accuracy-complexity trade-offs in nonlinear interpolation and mapping approaches.

****Class 6: Shallow Water Equations and Compressible Euler Equations (1 hour)****

- Shallow Water Equations: Introduction to the equations governing shallow water flows and their relevance in fluid dynamics.
- Compressible Euler Equations: Overview of compressible fluid dynamics using the Euler equations.
- Model Reduction Applications: Applying the learned techniques to reduce the dimensionality of the shallow water and compressible Euler equations.
- Final Remarks: Summarizing the course content, discussing potential further studies, and addressing any remaining questions.

Please note that this syllabus provides an overview of the topics to be covered in each class. Depending on the class's pace, the complexity of the topics, and the students' background, we might need to adjust the time allocated to each topic accordingly. Additionally, the "Hands-On Session" and "Numerical Examples" can involve practical coding exercises using appropriate software or programming languages.

Unique choice box: introductory course;

If course then ask for Recording of the course: yes/no. no

o Domain from Arxiv (e.g., Algebraic Geometry): Math.NA

o MSC: 65N06 & 65N08 & 65N30

o Keywords (separated by #): reduced order models