应用所科研人员近期研究成果

一、刘晓东研究员等人的论文 Identification of acoustic point sources in a two-layered medium from multi-frequency sparse far field patterns 被 INVERSE PROBLEMS 接收发表。

摘要：

We consider the reconstruction of point sources in a two layered medium from the multi-frequency sparse far field patterns taken on the upper half sphere. The point sources are located in both the upper half space and the lower half space, and consequently bring difficulty for the inverse problem because of the combination of two different types of far field patterns. After establishing the uniqueness of the point sources by the multi-frequency far field patterns at properly chosen sparse observation directions, we introduce a multi-step numerical scheme for identifying all the points sources. Numerical examples show that the proposed sampling methods work very well for locating the positions and the formulas for determining the corresponding scattering strengths are valid and stable with respect to the noises.

论文链接：http://dx.doi.org/10.1088/1361-6420/accaa0

二、王启华研究员等人的论文 A robust fusion-extraction procedure with summary statistics in the presence of biased sources 被 BIOMETRIKA 接收发表。

摘要：

Information from multiple data sources is increasingly available. However, some data sources may produce biased estimates due to biased sampling, data corruption or model misspecification. Thus there is a need for robust data combination methods that can be used with biased sources. In this paper, a robust data fusion-extraction method is proposed. Unlike existing methods, the proposed method can be applied in the important case where researchers have no knowledge of which data sources are unbiased. The proposed estimator is easy to compute and employs only summary statistics; hence it can be applied in many different fields, such as meta-analysis, Mendelian randomization and distributed systems. The proposed estimator is consistent, even if many data sources are biased, and is asymptotically equivalent to the oracle estimator that uses only unbiased data. Asymptotic normality of the proposed estimator is also established. In contrast to existing meta-analysis methods, the theoretical properties are guaranteed for our estimator, even if the number of data sources and the dimension of the parameter diverge as the sample size increases. Furthermore, the proposed method provides consistent selection for unbiased data sources with probability approaching 1. Simulation studies demonstrate the efficiency and robustness of the proposed method empirically. The method is applied to a meta-analysis dataset to evaluate surgical treatment for moderate periodontal disease and to a Mendelian randomization dataset to study the risk factors for head and neck cancer.

论文链接：http://dx.doi.org/10.1093/biomet/asad013

三、郑好助理研究员等人的论文 An Intrinsically Hydrodynamic Approach to Multidimensional QHD Systems 被 ARCHIVE FOR RATIONAL MECHANICS AND ANALYSIS 接收发表。

摘要：

In this paper we consider the multi-dimensional Quantum Hydrodynamics (QHD) system, by adopting an intrinsically hydrodynamic approach. The present paper continues the analysis initiated in Antonelli et al. (Commun Math Phys 383:2113-2161, 2021) where the one dimensional case was investigated. Here we extend the analysis to the multi-dimensional problem, in particular

by considering two physically relevant classes of solutions. First of all we consider two-dimensional initial data endowed with point vortices; by assuming the continuity of the mass density and a quantization rule for the vorticity, we are able to study the Cauchy problem and provide global finite energy weak solutions. The same result can be obtained also by considering spherically symmetric initial data in the multi-dimensional setting. For rough solutions with finite energy, we are able to provide suitable dispersive estimates, which also apply to a more general class of Euler-Korteweg equations. Moreover we are also able to show the sequential stability of weak solutions with positive density. Analogously to the one dimensional case, this is achieved through the a priori bounds given by a new functional, first introduced in Antonelli et al. (2021).

论文链接：http://dx.doi.org/10.1007/s00205-023-01856-x

四、朱湘婵研究员等人的论文 GLOBAL-IN-TIME PROBABILISTICALLY STRONG AND MARKOV SOLUTIONS TO STOCHASTIC 3D NAVIER-STOKES EQUATIONS: EXISTENCE AND NONUNIQUENESS 被 ANNALS OF PROBABILITY 接收发表。

摘要：

We are concerned with the three-dimensional incompressible Navier- Stokes equations driven by an additive stochastic forcing of trace class. First, for every divergence free initial condition in L2 we establish existence of infinitely many global-in-time probabilistically strong and analytically weak solutions, solving one of the open problems in the field. This result, in partic-ular, implies nonuniqueness in law. Second, we prove nonuniqueness of the associated Markov processes in a suitably chosen class of analytically weak solutions satisfying a relaxed form of an energy inequality. Translated to the deterministic setting, we obtain nonuniqueness of the associated semiflows.

论文链接：http://dx.doi.org/10.1214/22-AOP1607

五、Smith Scott A 等人的论文 Phase Transitions, Logarithmic Sobolev Inequalities, and Uniform-in-Time Propagation of Chaos for Weakly Interacting Diffusions 被 COMMUNICATIONS IN MATHEMATICAL PHYSICS 接收发表。

摘要：

In this article, we study the mean field limit of weakly interacting diffusions for confining and interaction potentials that are not necessarily convex. We explore the relationship between the large N limit of the constant in the logarithmic Sobolev inequality (LSI) for the N-particle system and the presence or absence of phase transitions for the mean field limit. We show that the non-degeneracy of the LSI constant implies uniform-in-time propagation of chaos and Gaussianity of the fluctuations at equilibrium. As byproducts of our analysis, we provide concise and, to our knowledge, new proofs of a generalised form of Talagrand's inequality and of quantitative propagation of chaos by employing techniques from the theory of gradient flows, specifically the Riemannian calculus on the space of probability measures.

论文链接：http://dx.doi.org/10.1007/s00220-023-04659-z

六、陈旭瑾研究员等的论文 Packing Feedback Arc Sets in Tournaments Exactly 被 MATHEMATICS OF OPERATIONS RESEARCH 接收发表。

摘要：

Let T = (V,A) be a tournament with a nonnegative integral weight w(e) on each arc e. A subset F of arcs is called a feedback arc set (FAS) if T\F contains no cycles (directed). A collection F of FASs (with

repetition allowed) is called an FAS packing if each arc e is used at most w(e) times by the members of F. The purpose of this paper is to give a characterization of all tournaments T = (V,A) with the property that, for every nonnegative integral weight function w defined on A, the minimum total weight of a cycle is equal to the maximum size of an FAS packing.

论文链接：http://dx.doi.org/10.1287/moor.2023.1352

七、郑作环研究员等人的论文 Exact Mobility Edges for 1D Quasiperiodic Models 被 COMMUNICATIONS IN MATHEMATICAL PHYSICS 接收发表。

摘要：

Mobility edges (ME), i.e. critical energies which separate absolutely continuous spectrum and pure point spectrum, is an important issue in quantum physics. So far there are two experimentally feasible 1D quasiperiodic models that have been discovered to have exact mobility edges. However, all the theoretical studies have remained at the numerical level. In this paper, we rigorously prove and precisely locate of the MEs for these models.

论文链接：http://dx.doi.org/10.1007/s00220-023-04695-9

八、王勇研究员等的论文 Combining genome-wide association studies highlight novel loci involved in human facial variation 被 NATURE COMMUNICATIONS 接收发表。

摘要：

Standard genome-wide association studies (GWASs) rely on analyzing a single trait at a time. However, many human phenotypes are complex and composed by multiple correlated traits. Here we introduce C-GWAS, a method for combining GWAS summary statistics of multiple potentially correlated traits. Extensive computer simulations demonstrated increased statistical power of C-GWAS compared to the minimal p-values of multiple single-trait GWASs (MinGWAS) and the current state-of-the-art method for combining single-trait GWASs (MTAG). Applying C-GWAS to a meta-analysis dataset of 78 single trait facial GWASs from 10,115 Europeans identified 56 study-wide suggestively significant loci with multi-trait effects on facial morphology of which 17 are novel loci. Using data from additional 13,622 European and Asian samples, 46 (82%) loci, including 9 (53%) novel loci, were replicated at nominal significance with consistent allele effects. Functional analyses further strengthen the reliability of our C-GWAS findings. Our study introduces the C-GWAS method and makes it available as computationally efficient open-source R package for widespread future use. Our work also provides insights into the genetic architecture of human facial appearance. Combining multiple related traits can increase power in genetic association studies. Here, the authors develop a method to integrate GWAS statistics for multiple traits and apply it to find genetic loci affecting human facial variation.

论文链接：http://dx.doi.org/10.1038/s41467-022-35328-9

九、曹道民研究员等人的论文 Structure of Green's function of elliptic equations and helical vortex patches for 3D incompressible Euler equations 被 MATHEMATISCHE ANNALEN 接收发表。

摘要：

We develop a new structure of the Green's function of a second-order elliptic operator in divergence form in a 2D bounded domain. Based on this structure and the theory of rearrangement of functions, we construct concentrated traveling-rotating helical vortex patches to 3D incompressible Euler equations in an infinite pipe. By solving an equation for vorticity w =

1/epsilon(2) f epsilon GK(H) w - alpha/2 |x|(2)| ln epsilon| in omega for small epsilon > 0 and considering a certain maximization problem for the vorticity, where G(KH) is the inverse of an elliptic operator L(KH)in divergence form, we get the existence of a family of concentrated helical vortex patches, which tend asymptotically to a singular helical vortex filament evolved by the binormal curvature flow. We also get nonlinear orbital stability of the maximizers in the variational problem under L-p perturbation when p >= 2.

论文链接：http://dx.doi.org/10.1007/s00208-023-02589-8

十、王益研究员等人的论文 **Time-asymptotic stability of composite waves of viscous shock and rarefaction for barotropic Navier-Stokes equations** 被 **ADVANCES IN MATHEMATICS** 接收发表。

摘要：

We prove the time-asymptotic stability of composite waves consisting of the superposition of a viscous shock and a rarefaction for the one-dimensional compressible barotropic Navier-Stokes equations. Our result solves a long-standing problem first mentioned in 1986 by Matsumura and Nishihara in [28]. The same authors introduced it officially as an open problem in 1992 in [29] and it was again described as very challenging open problem in 2018 in the survey paper [26]. The main difficulty is due to the incompatibility of the standard anti-derivative method, used to study the stability of viscous shocks, and the energy method used for the stability of rarefactions. Instead of the anti-derivative method, our proof uses the a-contraction with shifts theory recently developed by two of the authors. This method is energy based, and can seamlessly handle the superposition of waves of different kinds.

论文链接：http://dx.doi.org/10.1016/j.aim.2023.108963

十一、曹道民研究员等人的论文 **REMARKS ON ORBITAL STABILITY OF STEADY VORTEX RINGS** 被 **TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY** 接收发表。

摘要：

In this paper, we study nonlinear orbital stability of steady vortex rings without swirl, which are special global solutions of the three-dimensional incompressible Euler equations. We prove the existence of orbitally stable steady vortex rings. The proof is based on the classical variational method.

论文链接：http://dx.doi.org/10.1090/tran/8888