Prabir Daripa

Some Selected Papers with Links to Related Papers

The texts marked in blue are hyperlinks. You should be able to access the hyperlinks by placing and then clicking the mouse on these blue colored texts.

1. "On Applications of a Complex Variable Method in Compressible Flows," **J. Comp. Phys.**, 88(2), pp. 337–361, 1990. **This paper lays the framework for solving directly without any iteration** *nonlinear* **potential flow equations of compressible flows in the plane using the theory of single complex variable. This technique is then used to design subcritical airfoils in one-shot as one would in incompressible flows.**

2. "Solvability Condition and its Application to Fast Numerical Solution of Overposed Problems in Compressible Flows", **J. Comp. Phys.**, 95(1), pp. 436–449, 1991. **This paper** is the underpinning of why an overposed inverse design problem in subcritical compressible flow can be solved in a direct fashion shown in "On Applications of a Complex Variable Method in Compressible Flows" **J. Comp. Phys.**, 88(2), pp. 337–361, 1990. It also shows the synergy between theory and numerics that helps solve such a difficult problem so rapidly.

3. "A Fast Algorithm to Solve Non-Homogeneous Cauchy-Riemann Equations in the Complex Plane," **SIAM J. Sci. Stat. Comput.**, 13(6), pp. 1418–1432, 1992. **This paper lays the foundation of what has now been christened as FFTRR algorithms for fast and accurate evaluation of singular integrals of the kind that appear in the Green's functions of various elliptic operators. This, and subsequent algorithmically related papers, established the field of FFTRR algorithms. These algorithms are highly parallelizable by their construction. In these papers, you will find such analysis driven FFTRR algorithms developed and applied for a variety of PDEs such as Poisson equations, biharmonic equations, Helmholtz equations, Beltrami equations and so on.**

4. "A Fast Algorithm to Solve the Beltrami Equation with Applications to Quasiconformal Mappings," **J. Comp. Phys.**, 106(2), pp. 355–365, 1993. **This, and related**

papers, **develop numerical methods for generating quasiconformal maps, a fundamental problem considering that many problems in mechanics among other fields of classical physics involve precisely this. This is also fundamental for many problems in pure mathematics: see some** works of others **which cite and exemplify the relevance of our work on QMAPs.**

5. "A Fast Parallel Algorithm for the Poisson Equation on a Disks," **J. Comp. Phys.**, 169, pp. 151-192, 2001. (with L. Borges) **This, and** related papers **develop FFTRR-based Fast** Parallel **Algorithms in real plane, in particular for the Poisson equation.**

6. "The FFTRR-based Fast Decomposition Methods for Solving Complex Biharmonic Problems and Incompressible Flows," **IMA J. Numer.. Anal.**, 36(2), pp. 824–850, 2016. **This, and** another paper**, develop FFTRR based fast numerical algorithms for solving complex biharmonic problem within unit disk. These fast algorithms can be used to solve many problems in the real plane as well. These papers show how to apply these to solving Stokes flow problem within a unit disk.**

7. "On a Boundary Control Approach to Domain Embedding Method," **SIAM J. Cont. Opt.**, 40(2), pp. 421-449, 2001. (with L. Badea) **This, and** related papers**, develop control theoretic domain embedding techniques in combination with fast algorithms for regular domains (specifically our** FFTRR algorithms **for a disk) to solve rapidly the PDEs in complex domains.**

8. "A brief review of some application driven fast algorithms for elliptic partial differential equations", **Central European Journal of Mathematics**, 10(1), 204-216, 2012. **This paper documents briefly the application that led to the development of** FFTRR based fast algorithms**, the basic and simple ideas that went into the development of these algorithms, and subsequent application, extension, transformation and evolution of these algorithms up until the time the paper was written.**

9. "Polymer Floods: A Case Study of Nonlinear Wave Analysis And of Instability Control In Tertiary Oil Recovery," (with J. Glimm, B. Lindquist, O. McBryan) **SIAM J. Appl. Math.**, **48**, 353–373, 1988. **This, and** related papers **apply successfully with remarkable accuracy a Front Tracking method, which uses the**

Riemann solver for a 2×2 non-strictly hyperbolic system of conservations laws, to the problem of enhanced oil recovery by polymer flooding and to reservoir simulation in general.

10. "Modeling and Simulation of Surfactant-Polymer Flooding using a New Hybrid Method", (with Sourav Dutta) **J. Comp. Phys.**, 335, pp. 249-282, 2017. **This paper develops global pressure formulation for multiphase porous media flow in the presence of components and solves coupled nonlinear system of complex PDEs arising in the context of chemical enhanced oil recovery using a new hybrid numerical method proposed by Daripa and Dutta. The hybrid method makes use of a discontinuous finite element method (DFEM) and modified method of characteristics (MMOC).**

11. "Convergence analysis of a characteristics-based hybrid method for multicomponent transport in porous media", (with Sourav Dutta) **Appl. Numer. Math.**, 146, pp. 199-220, 2019. **Convergence of the DFEM-MMOC based hybrid method has been proved in this paper.**

12. "Linear instability of viscoelastic interfacial Hele-Shaw flows: a Newtonian fluid displacing an UCM fluid", (with Zhiying Hai) **Journal of Non-Newtonian Fluid Mechanics.**, Vol. 303 (2022) 104773. **We theoretically study the linear stability of the SaffmanTaylor problem where a viscous Newtonian fluid displaces an Upper Convected Maxwell (UCM) fluid in a rectilinear Hele-Shaw cell.**

13. "Time-dependent injection strategies for multi-layer Hele-Shaw and porous media flows", (with Craig Gin) **Physical Review Fluids.**, Vol. 6, No. 3, Article No. 033901 (2021) DOI: 10.1103/PhysRevFluids.6.033901. **We use linear stability analysis to demonstrate how to stabilize multilayer radial Hele-Shaw and porous media flows with a time-dependent injection rate.**

14. "Stability Results on Radial Porous Media and Hele-Shaw Flows with Variable Viscosity between Two Moving Interfaces", (with Craig Gin) **IMA J. Appl. Math.**, 86(2), pp. 294-319, April 2021. **We perform a linear stability analysis of three-layer radial porous media and Hele-Shaw flows with variable viscosity in the middle layer.**

15. “Hydrodynamic stability of multi-layer Hele-Shaw flows,” **Jour. Stat. Mech.**, P12005, 32 pp., 2008. **This, and related papers established the field of linear stability for multilayer Hele-Shaw and porous media flows in rectilinear and radial geometries. These papers contain many fundamental results on a variety of non-standard eigenvalue problems and on the stabilization of these flows which can be fruitfully harnessed for a variety of applications including enhanced oil recovery.**

16. “Studies on Dispersive Stabilization of Porous Media Flows,” (with Craig Gin) **Phys. Fluids**, **28**, 082105, 2016. **This paper introduces the notion of diffusively permeable and diffusively impermeable interfaces and compares their stabilization potentials, within the Hele-Shaw model, of an otherwise unstable three-layer immiscible flow with and without dispersive effects of the components in the middle layer.**

17. “A Numerical Study of an Ill-posed Boussinesq Equation Arising in Water Waves and Nonlinear Lattices: Filtering and Regularization Techniques,” **Appl. Math. Comp.**, 101(2), pp. 159-207, 1999. **This, and related papers develop methods for construction of approximate solutions of linear and nonlinear illposed problems with gradually increasing order of growth rates of short wave instabilities, derive a class of model equations for bidirectional propagation of capillary-gravity waves in shallow water, and perform analysis related to local and nonlocal solitary wave solutions of Bossinesq equations.**

18. “Generalized Circle and Sphere Theorems for Inviscid and Viscous Flows with Applications,” **SIAM J. Appl. Math.**, 62(2), pp. 514–540, 2001. (with D. Palaniappan) **In this paper, circle and sphere theorems are developed for a composite double body and then applied to several flow problems.**

19. “Compound Droplet in Extensional and Paraboloidal Flows,” **Physics of Fluids**, 12, pp. 2377–2385, 2000. (with D. Palaniappan) **In this and related papers, methods for generating a variety of Stokes flows, some driven by line singularities in plane and some around two-sphere geometry, are developed.**