

SAIKIRAN RAPAKA

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EDUCATION

Ph.D , Mechanical Engineering	Johns Hopkins University	Aug 2009
M.S.E , Mechanical Engineering	Johns Hopkins University	Aug 2005
M.Tech and B.Tech , Chemical Engineering	Indian Institute of Technology Madras	May 2003

WORK EXPERIENCE

Postdoctoral Research Associate, Computational Earth Sciences, Los Alamos National Laboratory Nov 2009 - Present

- Developed elastic and plastic geomechanical models for the Finite Element Heat and Mass Transport (FEHM) simulator.
- Performed coupled simulations of thermo-hydro-mechanical processes for problems related to geological storage of carbon dioxide and enhanced geothermal systems.
- Studied the impact of background aquifer flow on the rate of dissolution of carbon dioxide into subsurface brine.

RESEARCH EXPERIENCE

Geological sequestration of carbon dioxide, Johns Hopkins University Aug 2006 – Aug 2009

- Analyzed the conditions under which convective flow patterns emerge due to dissolution of supercritical carbon dioxide into brine in the aquifer.
- Applied non-modal instability analysis to obtain length and time-scales of the onset of density-driven convection. This work provided a solution to the long-standing issue of instability of fluid flows with time-dependent base states.
- Developed a three-dimensional, parallel, pseudo-spectral solver to simulate the onset and subsequent nonlinear evolution of the convective flow. The numerical simulations were shown to match well with the theoretical model and provided insight into the nonlinear development of instability.
- Extended the non-modal analysis to anisotropic and heterogeneous permeability fields. This work was one of the first theoretical investigations of transient growth of perturbations in heterogeneous systems.
- Developed a Finite-Volume solver for the governing equations in heterogeneous media. The growth rates of instability computed from simulations compared well with those predicted from theory.
- Dissertation: *Fluid Flow and Transport Phenomena during Geological Sequestration of Carbon Dioxide*.

Lattice-Boltzmann simulations of fluid-structure interactions, Johns Hopkins University Aug 2007 – Jan 2009

- Implemented a lattice-Boltzmann simulator for modeling the sedimentation of fully resolved elliptical particles in narrow channels.
- Analyzed the particle's dynamics over a wide range of non-dimensional parameters and showed 5 distinct modes of sedimentation: oscillating, tumbling, horizontally aligned, vertically aligned and an inclined mode of sedimentation.
- Extended and parallelized the solver to simulate three-dimensional fully resolved particle-fluid systems.

Fourier-Chebyshev spectral solver for channel flows, IIT Madras May 2002 – May 2003

- Developed a spectral solver for microchannel flows using Fourier expansions in the streamwise and spanwise directions and a Chebyshev expansion in the wall-normal direction.
- Thesis: *Direct Numerical Simulations of Slip Flow in a Channel*.

RANS simulations of turbulent flow in curved ducts, Bharat Heavy Electricals Ltd. May 2001 – Aug 2001

- Performed numerical simulations of turbulent flow in curved ducts using the PHOENICS software suite.
- Compared various turbulence models with available experimental data.

HONORS

- Outstanding Student Poster Award for the poster “Critical times for the onset of density-driven convection in anisotropic porous media” at the 2006 Fall meeting of the American Geophysical Union
- Achieved 98.86 percentile in the Graduate Aptitude Test of Engineering (GATE) in Chemical Engineering
- Ranked among top 1.5% of applicants in the Joint Entrance Examination (1998) for entrance into Indian Institutes of Technology.

PUBLICATIONS

1. S. Rapaka, S. Chen, R. J. Pawar, P. H. Stauffer and D. Zhang, *Non-modal growth of perturbations in density-driven convection in porous media*, J. Fluid Mech, vol 609, p285-303, 2008.
2. Z.-H. Xia, K. Connington, S. Rapaka, P. Yue, J. J. Feng and S. Chen, *Flow patterns in the sedimentation of an elliptical particle*, J. Fluid Mech, vol 625, p249-272, 2009.
3. S. Rapaka, S. Chen, D. Zhang, R. J. Pawar and P. H. Stauffer, *Onset of convection over a transient base-state in anisotropic and layered porous media*, J. Fluid Mech., vol 641, p227-244, 2009.
4. S. Rapaka, G. Zyvoloski, S. Kelkar and Y. Keita, *Efficient finite-element calculations for nonlinear problems*, (In preparation).
5. S. Rapaka, R. Pawar, *A fast numerical method for three-dimensional boundary layer evolution in porous media*, (In preparation).
6. S. Rapaka, R. Pawar, *Role of background flow for carbon sequestration in saline aquifers: Implications for monitoring*, (In preparation).

TECHNICAL SKILLS

Languages	C, C++, FORTRAN 90, Java, PERL
Applications	MATLAB, Octave, MySQL, LaTeX
Operating Systems	Linux, Unix, Solaris, Windows
Libraries	MPI, FFTW, PetSc
Computational Methods	Lattice-Boltzmann, Spectral, Finite-Volume and Finite-Element methods

PROFESSIONAL SERVICE

Journal Referee

- Journal of Fluid Mechanics
- Journal of Computational Physics
- SPE Journal
- Transport in Porous Media
- International Journal of Modern Physics C
- International Journal of Heat and Fluid Flow

EXTRA-CURRICULAR ACTIVITIES

- Designed and implemented the IIT Madras website, back-end database and associated PERL scripts.
- Linux network administrator for the Department of Chemical Engineering, IIT Madras.
- Won prizes in debates and social competitions.