Curriculum Vitae Aslan R. Kasimov

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Citizenship: Russia
Visa: US permanent resident

Education:

Ph.D. in Theoretical & Applied Mechanics, *University of Illinois, Urbana-Champaign*, 2004.
Area of research: Detonation stability and dynamics, reacting flows, combustion.
M.S. in Mechanical & Aerospace Engineering, *University of Virginia*, 1999.
Area of research: Numerical simulation of particle combustion.
Diploma in Physics, *Moscow Engineering-Physics Institute*, Moscow, Russia, 1993.
Area of specialization: Physics of combustion and detonation.

Awards:

- 2007 - Young Investigator Program Award, AFOSR.
- 2004 - Larson Graduate Award, Department of Theoretical & Applied Mechanics, UIUC
- 2001, 2002 - Mavis Memorial Fund Scholarship, UIUC.

Research experience:

Post-doctoral research: Department of Mathematics, MIT, 2005 – present.

- ***Numerical simulation of detonation waves.*** Developed a new numerical algorithm for highly accurate simulation of multi-dimensional shock and detonation waves. This work is supported by the AFOSR Young Investigator Program.
- ***Theory of detonations*.** Asymptotic analysis of the dynamics of detonation waves is developed that describes detonation initiation and failure in gaseous and condensed-phase energetic materials. The resultant nonlinear evolution equation is employed in the simulation of two-dimensional detonations in a channel and is shown to predict detonation cell formation.
- ***Shocks in shallow-water theory.*** Developed a new model for the structure of a circular hydraulic jump that accounts for viscous losses and surface tension effects. Non-existence of a steady circular jump at large surface tensions is predicted. Linear stability theory and a numerical model are being developed for the analysis of the instability of the circular hydraulic jump and, more generally, of shock waves in shallow-water theory.
- ***Shocks in traffic flow*.** A rigorous mathematical theory of self-sustained traffic jams ("jamitons") is derived on the basis of the analogy between the traffic jams and detonation waves.
- ***Bio-fluid mechanics: elastic jumps***. Currently I am working on understanding the nature of elastic jumps in fluid flow in elastic tubes and elucidation of their role of in onset of aneurysms and syringomyelia.
- ***The mathematics of sonic points***. Differential equations describing many natural phenomena involve resolvable singularities of the sonic-point type. Their nature in linear stability problems and general formulation of non-linear hyperbolic problems remains elusive and is a challenging problem of importance to such diverse areas as: detonation theory, shallow-water flows, fluid flows in flexible tubes, traffic flows, granular flows, and astrophysical accretion flows.

Post-doctoral research: Theoretical & Applied Mechanics, UIUC, 2004 – 2005.

- ***Weakly-nonlinear theory of self-sustained detonations*.** Theoretical description of high-order detonation shock dynamics for fully non-linear evolution is developed.

Doctoral research: Theo. & Applied Mechanics, UIUC, 1999–2004 (advisor: D. S. Stewart).

- ***Detonation stability theory*.** Developed a model for three-dimensional instability of gaseous detonations propagating in circular tubes. A mathematical formulation for the linear instability of detonation of condensed explosives with complex constitutive description is developed.
- ***Asymptotic theory of detonation waves*.** A rigorous mathematical formulation is developed for the description of detonation waves with an embedded sonic locus. The theory generalizes and clarifies previously known steady and quasi-steady formulations and provides a unified approach for further analytical and numerical studies of multi-dimensional unsteady detonations.
- ***Numerical simulation of detonations*.** Developed an algorithm for high-resolution simulations of one-dimensional detonations in a shock-attached frame.

Master's research: Mechanical & Aerospace Engineering, University of Virginia, 1997–1999.

- ***Numerical simulation of carbon particle combustion*.** Developed a mathematical model and a numerical code for simulation of heterogeneous combustion within and on the surface of a porous carbon particle and homogeneous gas-phase reaction around the particle. The model accounts for complex pore structure with variable pore size and multi-component reaction kinetics and species transport in the gas phase.

Other research: N. Semenov Institute of Chemical Physics, Moscow, Russia, 1993–96.

- ***Numerical simulation of gaseous and two-phase detonations*.** Developed one- and two-dimensional numerical models for calculations of the gas-phase and heterogeneous detonations in dilute mixtures with global description of the heat-release kinetics.

Research interests:

Applied mathematics, nonlinear dynamics, fluid mechanics, shock dynamics, nonlinear waves, detonation and combustion theory, numerical methods, hydrodynamic stability theory, traffic flow, bio-fluid dynamics, astrophysical flows.

Research collaborators:

R. R. Rosales (MIT), J. Bush (MIT), B. Seibold (MIT), J.-C. Nave (MIT), M.R. Flynn (University of Alberta), B. Taylor (Illinois), D.S. Stewart (UIUC).

Teaching experience:

Instructor in Applied Mathematics, MIT.

- *Mathematical Methods for Engineers (Graduate), 18.085, 2006, 2007, 2008.* Lecturer.
- *Linear Partial Differential Equations (Undergraduate), 18.303, 2007.* Lecturer.
- *Linear algebra (Undergraduate), 18.06, 2006,* Recitation instructor.
- *Differential Equations (Undergraduate), 18.03, 2005, 2006,* Recitation instructor.

Instructor and Teaching Assistant, University of Illinois, Urbana-Champaign.

- *Introduction to Fluid Mechanics,* 2002. Instructor. Designed and co-taught the course.
- *Fluid Mechanics Laboratory, 1999.* Teaching Assistant. Introduced students to the laboratory equipment and supervised the experiments.

Teaching Assistant, University of Virginia, Charlottesville.

- *Graduate Partial Differential Equations,* 1997. Conducted discussion sessions.
- *Calculus*, 1998. Discussion sessions.
- *Engineering Thermodynamics,* 1998. Supervised laboratory experiments.

Teaching interests:

Applied mathematics, fluid mechanics and gas dynamics, wave motion, numerical methods, nonlinear dynamics.

Membership in professional societies:

APS, SIAM, Combustion Institute.

A.R. Kasimov's publication list

Publications:

- M. R. Flynn, A. R. Kasimov, J.-C. Nave, R.R. Rosales, B. Seibold, **Self-sustained nonlinear waves in traffic flow, 2008** (Submitted for publication in *Physical Review E*. arXiv:0810.2820v1)
- M. R. Flynn, A. R. Kasimov, J.-C. Nave, R.R. Rosales, B. Seibold, **On "jamitons," self-sustained nonlinear traffic waves, 2008** (In preparation. arXiv:0809.2828v2).
- B. Taylor, A. R. Kasimov, D.S. Stewart, **Mode selection in weakly unstable two-dimensional detonations, 2008** (Submitted for publication in *Combustion Theory and Modeling*.)
- A. R. Kasimov, **Hyperbolic dynamics of weakly curved detonations, 2008** (Submitted for publication in *Combustion Theory and Modeling*).
- A. R. Kasimov, **A stationary circular hydraulic jump, the limits of its existence and its gasdynamic analogue, 2008**, *Journal of Fluid Mechanics, 601, 189-198.*
- D. S. Stewart and A. R. Kasimov, **State of detonation stability theory and its application to propulsion, 2006,** *Journal of Propulsion and Power, 22, No. 6, 1230-1244.*
- D. S. Stewart and A. R. Kasimov, **Theory of detonation with an embedded sonic locus, 2005,** *SIAM Journal of Applied Mathematics, 66, No. 2, 384-407.*
- A. R. Kasimov and D. S. Stewart, **Asymptotic theory of evolution and failure of self-sustained detonations, *2005***, *Journal of Fluid Mechanics, 525, 161-192.*
- A. R. Kasimov and D. S. Stewart, **On the dynamics of self-sustained detonations: A numerical study in the shock-attached frame, *2004***, *Physics of Fluids, 16(10), 3566-3578.*
- A. R. Kasimov and D. S. Stewart, **Theory of detonation initiation and comparison with experiment, *2004,*** *Report № 1035, Theoretical & Applied Mechanics, UIUC.*
- A. R. Kasimov and D. S. Stewart, **Spinning instability of gaseous detonations, *2002***, *Journal of Fluid Mechanics, 466, 179-203.*
- A.A. Borisov, O.I. Mel'nichuk, A.R. Kasimov, B.A. Khasainov, K.Ya. Troshin, and V. Kosenkov, **On the energy evolution in gaseous detonation waves, *1995***. *J. de PHYSIQUE IV, C4, Vol. 5.*

Selected conference presentations:

- A. R. Kasimov, Kinematics and dynamics of multi-dimensional shock waves with application to detonation simulation, *12th Intl Conference on Numerical Combustion,* Monterey, CA, 2008.
- B.D. Taylor, A. R. Kasimov, D.S. Stewart. Mode selection in unstable two-dimensional detonations, *12th Intl Conference on Numerical Combustion,* Monterey, CA, 2008.
- A. R. Kasimov, Explosion in a kitchen sink – a theory of circular hydraulic jump and its gasdynamic analogue, 60*th Annual Meeting of APS DFD*, Salt lake City, UT, 2007.
- A. R. Kasimov, On the nonlinear dynamics of slowly evolving weakly curved detonation waves, *21st ICDERS*, Poitiers, France, 2007
- A. R. Kasimov, On a reduced description of reactive Euler equations of detonation theory, *SIAM Annual Meeting, Boston, 2006.*
- A. R. Kasimov and D. S. Stewart, Theory of direct initiation of gaseous detonations, *10th International Conference on Numerical Combustion,* Sedona, AZ, 2004.
- A. R. Kasimov, B. L. Wescott, D. S. Stewart, and S. Yoo, The structure and stability of high-explosive detonation waves, *19th ICDERS*, Hakone, Japan, 2003.
- A. R. Kasimov and D. S. Stewart, Theory of direct initiation and failure of gaseous detonations, *56th Annual Meeting of APS Division of Fluid Dynamics*, NJ, 2003.
- A. R. Kasimov and D. S. Stewart, Detonation waves with embedded sonic surfaces, *55th Annual Meeting of APS Division of Fluid Dynamics*, Dallas, Texas, 2002.
- A. R. Kasimov and D. S. Stewart, Spinning instability of gaseous detonations, *9th International Conference on Numerical Combustion,* Sorrento, Italy, 2002.