

## CURRICULUM VITA

Martin Maxey

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### **Name, position and departments**

Martin R. Maxey

Emeritus Professor of Applied Mathematics and Engineering

Professor (Research) of Applied Mathematics

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### **Education**

B.A., Mathematics, University of Cambridge, 1974.

Mathematics Tripos Part III, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, 1975. M. Math degree awarded April, 2011.

M.A., University of Cambridge, 1977.

Ph.D., Department of Applied Mathematics and Theoretical Physics, University of Cambridge, 1979. Thesis: *Aspects of unsteady turbulent shear flow, turbulent diffusion and tidal dispersion.*

### **Appointments**

Pre-doctoral Research Fellow, Woods Hole Oceanographic Institute, Geophysical Fluid Dynamics Summer Program, July-August 1977.

Post-doctoral Research Fellow, Department of Mechanics and Material Science, The Johns Hopkins University, Baltimore, 1979-1980.

Lecturer and Post-doctoral Research Fellow, Department of Chemical Engineering, The Johns Hopkins University, Baltimore, 1980-1981.

Lecturer and Visiting Associate Research Scientist, Department of Chemical Engineering, The Johns Hopkins University, Baltimore, 1981-1982.

Assistant Professor, Division of Applied Mathematics, Brown University, Providence, September 1982 - June 1987.

Associate Professor, Division of Applied Mathematics, Brown University, Providence, July 1987 - December 1987.

Associate Professor of Applied Mathematics and Engineering, Brown University, Providence, January 1988 - June 1992.

Professor of Applied Mathematics and Engineering, Brown University, Providence, July 1992 to June 2022.

Director, Center for Fluid Mechanics, Turbulence and Computation, July 1991 to February 2020.

Emeritus Professor of Applied Mathematics and Engineering, Brown University, Providence, July 2022.

Professor (Research) of Applied Mathematics, Brown University, Providence, July 2022 to present.

## **Completed Publications**

### **Chapters in books**

J.C.R. Hunt and M.R. Maxey, 1978. Estimating velocities and shear stress in turbulent flows of liquid metals driven by low frequency electromagnetic fields, Proceedings of the 2nd Bat-Sheva Intl. Seminar on MHD Flows and Turbulence, (eds. H. Branover and A. Yakhot) Israel Universities Press, 249-269.

L. Sirovich, M.R. Maxey and H. Tarman, 1988. An eigenfunction analysis of turbulent thermal convection. Proceedings of the Sixth Symposium on Turbulent Shear Flows, (ed. B.E. Launder) Springer Verlag, 68-77.

M.R. Maxey and E.J. Chang, 1996. Direct simulations of microbubble dynamics and turbulent flow. Proceedings of the 3rd International Symposium on Engineering Turbulence Modelling and Measurements, (eds. W. Rodi and G. Bergeles) Elsevier, 273-278.

J. Xu, S. Dong, M. Maxey and G. Karniadakis, 2003. Direct numerical simulation of turbulent channel flow with bubbles. Current Trends in Scientific Computing: ICM2002-Beijing Satellite Conference on Scientific Computing, August 15-18, 2002, Xi'an Jiaotong University, Xi'an, China, (eds. Z. Chen, R. Glowinski, and K. Li). Contemporary Mathematics (Am. Math. Soc, Providence, R.I.) v. **329**, 347-354.

M. R. Maxey, D. Liu, S. Dong, G. E. Karniadakis, 2006. New Advances in Force-Coupling Method: from micro to macro. Proceedings of IUTAM Symposium on Computational Approaches to Disperse Multiphase Flow, S. Balachandar and A. Prosperetti (eds), pp. 237-246, Springer.

E. Climent and M.R. Maxey, 2008. The Force Coupling Method: A flexible approach for the simulation of particulate flows. "Methods for creeping flows", edited by F. Feuillebois and A. Sellier, Ressign Press.

M.R. Maxey and G.L. Dent, 2017. Modeling and Simulation of Discrete Particles in Fluid Flow. "Collective Dynamics of Particles", edited by C. Marchioli and G. Bouchet, CISM International Centre for Mechanical Sciences 576, Springer.

S. Balachandar and M.R. Maxey, 2022. Deterministic Extended Point Particle Models. "Modelling approaches and computational methods for particle-laden turbulent flows", edited by S. Subramaniam and S. Balachandar, Elsevier.

### **Refereed journal articles**

J.F. Keffer, J.G. Kawall, J.C.R. Hunt and M.R. Maxey, 1978. Uniform distortion of thermal velocity mixing layers. *J. Fluid Mech.* **86**: 465-490.

M.R. Maxey, 1981. Distortion of turbulence in flows with parallel streamlines. *J. Fluid Mech.* **124**: 261-282.

M.R. Maxey and J.J. Riley, 1983. Equation of motion for a small rigid sphere in a nonuniform flow. *Phys. Fluids* **26**: 883-889.

B.D. Marsh and M.R. Maxey, 1985. On the distribution and separation of crystals in convecting magma. *J. Volcanology and Geothermal Res.* **24**: 95-150.

M.D. Walker and M.R. Maxey, 1985. A whirling hot-wire anemometer with optical data transmission. *J. Phys. E: Sci. Instrum.* **18**: 516-521.

M.R. Maxey and S. Corrsin, 1986. Gravitational settling of aerosol particles in randomly oriented cellular flow fields. *J. Atmos. Sci.* **43**: 112-1134.

M.R. Maxey, 1987. The gravitational settling of aerosol particles in homogeneous turbulence and random flow fields. *J. Fluid Mech.* **174**: 441-465.

M.R. Maxey, 1987. The velocity skewness measured in grid turbulence. *Phys. Fluids* **30**: 935-938.

M.R. Maxey, 1987. The motion of small spherical particles in a cellular flow field. *Phys. Fluids* **30**: 1915-1928.

- S. Balachandar and M.R. Maxey, 1989. Methods for evaluating fluid velocities in spectral simulations of turbulence. *J. Comput. Phys.* **83**: 96-125.
- L. Sirovich, S. Balachandar and M.R. Maxey, 1989. Simulations of turbulent thermal convection. *Phys. Fluids A* **1**: 1911-1914.
- S. Balachandar, M.R. Maxey and L. Sirovich, 1989. Numerical simulations of high Rayleigh number convection. *J. Scientific Computing* **4**: 219-236 (1989).
- M.R. Maxey, 1990. On the advection of spherical and nonspherical particles in a nonuniform flow. *Phil. Trans. R. Soc. (London) A* **333**: 289-307.
- H. Shin and M.R. Maxey, 1991. Chaotic sedimentation of spheroidal particles in a cellular flow field. (IUTAM Symposium on the Fluid Mechanics of Stirring and Mixing, La Jolla, August 1990) *Phys. Fluids A* **3**: 1434.
- R. Mallier and M.R. Maxey, 1991. The settling of nonspherical particles in a cellular flow field. *Phys. Fluids A* **3**: 1481-1494.
- G. Ruetsch and M.R. Maxey, 1991. Small-scale feature of vorticity and passive scalar fields in homogeneous isotropic turbulence. *Phys. Fluids A* **3**: 1587-1597.
- L-P. Wang, M.R. Maxey, T.D. Burton and D.E. Stock, 1992. Chaotic dynamics of particle dispersion in fluids. *Phys. Fluids A* **4**: 1789-1804.
- G.R. Ruetsch and M.R. Maxey, 1992. The evolution of small-scale structures in homogeneous isotropic turbulence. *Phys. Fluids A* **4**: 2747-2766.
- L-P. Wang and M.R. Maxey, 1993. The motion of microbubbles in a forced isotropic and homogeneous turbulence. *Applied Scientific Res.* **51**: 291-296.
- L-P. Wang and M.R. Maxey, 1993. Settling velocity and concentration distribution of heavy particles in homogeneous, isotropic turbulence. *J. Fluid Mech.* **256**: 27-68.
- M.R. Maxey, E.J. Chang and L-P. Wang, 1994. Simulation of interactions between microbubbles and turbulent flows. *Applied Mech. Rev.* **47**(6): S70-S74.
- E.J. Chang and M.R. Maxey, 1994. Accelerated motion of rigid spheres in unsteady flow at low to moderate Reynolds number. Part I - Oscillatory motion. *J. Fluid Mech.* **277**: 347-379.
- E.J. Chang and M.R. Maxey, 1995. Accelerated motion of rigid spheres in unsteady flow at low to moderate Reynolds number. Part II - Accelerated motion. *J. Fluid Mech.* **303**: 133-153.
- J. Rubin, C.K.R.T. Jones and M.R. Maxey, 1995. Settling and asymptotic motion of aerosol particles in a cellular flow field. *J. of Nonlinear Sci.* **5**: 337-358.

- M.R. Maxey, E.J. Chang and L-P. Wang, 1996. Interactions of particles and microbubbles with turbulence. *Experimental Thermal and Fluid Science* **12**: 417-425.
- M.R. Maxey, B.K. Patel, E.J. Chang and L-P. Wang, 1997. Simulations of dispersed turbulent multiphase flow. *Fluid Dynamics Res.* **20**: 143-156.
- H. Shin and M.R. Maxey, 1997. The chaotic motion of nonspherical particles settling in a cellular flow field. *Phys. Rev. E* **56**: 5431-5444.
- M.R. Maxey and B.K. Patel, 2001. Localized force representations for particles sedimenting in Stokes flow. *Int. J. Multiphase Flow* **27**: 1603-1626.
- S. Lomholt, B. Stenum and M.R. Maxey, 2002. Experimental verification of the force coupling method for particulate flows. *Int. J. Multiphase Flow* **28**: 225-246.
- J. Xu, M.R. Maxey and G.E. Karniadakis, 2002. Numerical simulation of turbulent drag reduction using micro-bubbles. *J. Fluid Mech.* **468**: 271-281.
- D. Liu, M.R. Maxey and G.E. Karniadakis, 2002. A fast method for particulate microflows. *J. Microelectromechanical Systems* **11**: 691-702.
- S. Lomholt and M.R. Maxey, 2003. Force coupling method for particles sedimenting in a channel: Stokes flow. *J. Comput. Physics* **184**: 381-405.
- E. Climent and M.R. Maxey, 2003. Numerical simulation of random suspensions at finite Reynolds numbers. *Int. J. Multiphase Flow* **29**: 579-601.
- S. Dance and M.R. Maxey, 2003. Incorporation of lubrication effects into the force-coupling method for particulate two-phase flow. *J. Comput. Phys.* **189**: 212-238.
- S. Dance and M.R. Maxey, 2003. Particle density stratification in transient sedimentation. *Phys. Rev. E.* **68**: 031403.
- E. Climent, M.R. Maxey and G.E. Karniadakis, 2004. Dynamics of self-assembled chaining in magnetorheological fluids. *Langmuir* **20**, 507-513.
- S.L. Dance, E. Climent and M.R. Maxey, 2004. Collision barrier effects on the bulk flow in a random suspension. *Phys. Fluids* **16**: 828-831.
- D. Liu, M. Maxey and G.E. Karniadakis, 2004. Modeling and optimization of colloidal micro-pumps. *J. Micromech. Microeng.* **14**: 567-575.
- S. Dong, D. Liu, M.R. Maxey and G.E. Karniadakis, 2004. Spectral distributed Lagrange multiplier method: algorithm and benchmark tests. *J. Comput. Phys.* **195**: 695-717.

D. Liu, M.R. Maxey and G.E. Karniadakis, 2005. Simulations of dynamic self-assembly of paramagnetic microspheres in confined microgeometries. *J. Micromech. Microeng.* **15**: 2298-2306.

E. Keaveny, I. Pivkin, M. Maxey and G.E. Karniadakis, 2005. A comparative study between dissipative particle dynamics and molecular dynamics for simple- and complex geometry flows. *J. Chem. Phys.* **123**: 104107.

M.Y. Stephens, R.J. Oglesby and M. Maxey, 2005. A one-dimensional mixed layer ocean model for use in three-dimensional climate simulations: Control simulation compared to observations. *J. Climate* **18**: 2199-2221.

M. Abbas, E. Climent, O. Simonin and M.R. Maxey, 2006. Dynamics of bidisperse suspensions under Stokes flow: Linear shear flow and sedimentation. *Phys. Fluids* **12**: 121504.

R. Kunz, H. Gibeling, M. Maxey, G. Tryggvason, A. Fontaine and S. Ceccio, 2007. Validation of two-fluid Eulerian CFD modeling for microbubble drag reduction across a wide range of Reynolds numbers. *J. Fluids Eng.* **129**: 66-79.

E. Climent, K. Yeo, M.R. Maxey and G.E. Karniadakis, 2007. Dynamic self-assembly of spinning particles. *J. Fluids Engin.* **129**: 379-387.

J. Xu, S. Dong, M.R. Maxey and G.E. Karniadakis, 2007. Turbulent drag reduction by constant near-wall forcing. *J. Fluid Mech.* **582**: 79-101.

E.E. Keaveny and M.R. Maxey, 2008. Spiral swimming of an artificial micro-swimmer. *J. Fluid Mech.* **598**: 293-319.

E.E. Keaveny and M.R. Maxey, 2008. Interactions between co-moving magnetic micro-swimmers. *Phys. Rev. E* **77**: 041910.

V. Dobrushkin and M.R. Maxey, 2008. An improved boundary element formulation for the motion of spherical bubbles. *Differential Equations* **44**: 1305-1312.

E.E. Keaveny and M.R. Maxey, 2008. Modeling the magnetic interactions between paramagnetic beads in magnetorheological fluids. *J. Comput. Phys.* **227**: 9554-9571.

X. Luo, M.R. Maxey and G.E. Karniadakis, 2009. Smoothed profile method for particulate flows: Error analysis and simulations. *J. Comput. Phys.* **228**: 1750-1769.

D. Liu, E.E. Keaveny, M.R. Maxey and G.E. Karniadakis, 2009. Force coupling method for flow with ellipsoidal particles. *J. Comput. Phys.* **228**: 3559-3581.

- K. Yeo, S. Dong, E. Climent and M.R. Maxey, 2010. Modulation of homogeneous turbulence seeded with finite size bubbles or particles. *Int. J. Multiphase Flow* **36**: 221-233.
- K. Yeo and M.R. Maxey, 2010. Simulation of concentrated suspensions using the force-coupling method. *J. Comput. Phys.* **229**: 2401-2421.
- K. Yeo and M.R. Maxey, 2010. Dynamics of concentrated suspensions of non-colloidal particles in Couette flow. *J. Fluid Mech.* **649**: 205-231.
- K. Yeo and M.R. Maxey, 2010. Ordering transition of non-Brownian suspensions in confined steady shear flow. *Phys. Rev. E.* **81**: 051502.
- K. Yeo and M.R. Maxey, 2010. Rheology and ordering transitions of non-Brownian suspensions in a confined shear flow: Effects of external torques. *Phys. Rev. E.* **81**: 062501.
- K. Yeo and M.R. Maxey, 2010. Anomalous diffusion in wall-bounded non-Brownian suspensions in a steady shear flow. *European Phys. Lett.* **92**: 24008.
- M.R. Maxey, 2011. Biomimetics and ciliary propulsion. *J. Fluid Mech.* **678**: 1-4.
- K. Yeo and M.R. Maxey, 2011. Numerical simulations of concentrated suspensions of monodisperse particles in a Poiseuille flow, *J. Fluid Mech.* **682**: 491-518.
- B. Rosa, L.-P. Wang, M.R. Maxey, and W.W. Grabowski, 2011. An accurate and efficient method for treating aerodynamic interactions of cloud droplets. *J. Comput. Phys.* **230**: 8109-8133.
- G. Li, J. Besson, L. Nisimova, D. Munger, P. Mahautmr, J. X. Tang, M.R. Maxey and Y.V. Brun, 2011. Accumulation of swimming bacteria near a solid surface. *Phys. Rev. E* **84**: 041932.
- S.M.W. Reddy, A. Wentz, O. Aburto-Oropeza, M. Maxey, S. Nagavarapu, and H.M. Leslie, 2013. Evidence of market-driven size-selective fishing and the mediating effects of biological and institutional factors. *Ecological Applications* **23**: 726-741.
- M. Morse, A. Huang, G. Li, M.R. Maxey, and J.X. Tang, 2013. Molecular adsorption steers bacterial swimming at the air/water interface. *Biophysical J.* **105**: 21-28.
- K. Yeo & M.R. Maxey, 2013. Dynamics and rheology of concentrated, finite-Reynolds number suspensions in a homogeneous shear flow. *Phys. Fluids* **25**: 053303.
- N. Trask, M. Maxey, K. Kim, M. Perego, M.L. Parks, K. Yang, J. Xu, 2015 “A scalable consistent second-order SPH solver for unsteady low Reynolds number flows”, *Computer Methods in Applied Mechanics and Engineering* **289**: 155-178

N. Trask, M. Maxey, and X. Hu, 2016. Compact moving least squares: An optimization framework for generating high-order compact meshless discretizations. *Journal of Computational Physics* **326**: 596-611

M.R. Maxey, 2017. Simulation methods for particulate flows and concentrated suspensions. *Annual Review of Fluid Mechanics* **49**: 171-193.

M.R. Maxey, 2017. Droplets in turbulence: a new perspective (Focus on Fluids). *J. Fluid Mech.* **816**: 1-4.

F.R. Cui, A.A. Howard, M.R. Maxey and A. Tripathi, 2017. Dispersion of a suspension plug in oscillatory pressure-driven flow. *Physical Review Fluids* **2**: 094303.

N. Trask, M. Maxey, and X. Hu, 2018. A compatible high-order meshless method for the Stokes equations with applications to suspension flows. *J. Computational Physics* **355**: 310-326.

A.A. Howard and M.R. Maxey. 2018. Simulation study of particle clouds in oscillating shear flow. *J. Fluid Mech.* **852**: 484-506

A.A. Howard, M.R. Maxey and K. Yeo. 2018. Settling of heavy particles in concentrated suspensions of neutrally buoyant particles under uniform shear. *Fluid Dynamics Research* **50**: 041401

K. Zhang, Z. Li, M.R. Maxey, S. Chen, G.E. Karniadakis. 2019. Self-cleaning of hydrophobic rough surfaces by coalescence-induced wetting transition. *Langmuir* **35**: 2431-2442.

C. Lin, Z. Li, L. Lu, S. Cai, M. Maxey and G.E. Karniadakis. 2021. Operator learning for predicting multiscale bubble growth dynamics. *J. Chemical Physics* **154**, 104118.

C. Lin, M. Maxey, Z. Li and G.E. Karniadakis. 2021. A seamless multiscale operator neural network for inferring bubble dynamics. *J. Fluid Mech.* **929**: A18.

N. Fujisawa, T. Yamagata, A. Abe and M. Maxey. 2022. Characterization of swirling-flow behavior in complex pipeline using bubble trajectory method with stereo particle tracking/image velocimetry. *Flow Measurement and Instrumentation* **102**: 102159.

A. A. Howard, M.R. Maxey, and Stany Gallier. 2022. Bidisperse suspension balance model. *Phys. Rev. Fluids* **7**, 124301.

## Conference papers

M.R. Maxey, 1985. On aerosol particle settling in homogeneous turbulence, 5th Symposium on Turbulent Shear Flows, Cornell University (August 1985).

M.R. Maxey, 1985. A study of aerosol particles settling in homogeneous turbulence, 7th Symposium on Turbulence and Diffusion of the American Meteorological Society (November 1985).

L. Sirovich, M.R. Maxey and H. Tarman, 1987. Analysis of turbulent thermal convection, 6<sup>th</sup> Symposium on Turbulent Shear Flows, Toulouse, France (September 1987)

S. Balachandar and M.R. Maxey, 1987. On Aerosol particle coagulation in homogeneous turbulence, 6th Symposium on Turbulent Shear Flows, Toulouse, France (September 1987).

M.R. Maxey and S. Balachandar, 1989. Simulation results on the coagulation of aerosol particles in homogeneous turbulence, International Conference on Mechanics of Two-Phase Flows, Taipei, Taiwan (June 1989).

R.A. Katz and M.R. Maxey, 1992. Mechanics underlying transitional and turbulent boundary layer flow-induced noise in underwater acoustics, Proceedings of the 14th International Congress on Acoustics, Vol. I, B6-B8 (September 1992).

L-P. Wang and M.R. Maxey, 1992. Kinematical descriptions for mixing in stratified or homogeneous shear flows.

M.R. Maxey, 1993. The equation of motion for a small rigid sphere in a nonuniform or unsteady flow, ASME FED-Vol. 166, 57-62, Intl. Symp. on Gas-Solid Flows (June 1993).

L-P. Wang and M.R. Maxey, 1993. Interactions of heavy particles with small-scale flow structures in homogeneous isotropic turbulence, ASME-FED Vol. 166, 113-120, Intl. Symp. on Gas-Solid Flows, Washington, D.C. (June 1993).

M.R. Maxey, 1993. Characteristics of small droplet motion in turbulence, AIAA Paper 93-1877, AIAA/SAE/ASME/ASEE 29th Joint Propulsion Conference, Monterey, CA (June 1993).

M.R. Maxey, L-P. Wang and E.J. Chang, 1993. Interactions of particles and microbubbles with turbulence, Proceedings of the Third International Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics, Hawaii (October 1993).

L-P. Wang and M.R. Maxey, 1995. Particle transport in 3-D hyperviscous turbulence, ASME-FED Vol. 228, 419-424, 6th International Symposium on Gas-Solid Flows, Hilton Head, S.C. (August 1995).

M.R. Maxey and B.K. Patel, 1997. Force-coupled simulations of particle suspensions at zero and finite Reynolds numbers, ASME Fluids Engin. Div. Paper 97-3183.

M.R. Maxey and G.L. Dent, 1998. Some features of particle sedimentation at finite Reynolds numbers, Third International Conference on Multiphase Flow, ICMF'98, Lyon, France (June 1998).

Y. Hagiwara, H. Hana, S. Murai, M. Tanaka and M.R. Maxey, 1998. Local effect of polymers used for drag reduction on turbulent solvent duct flow, Third International Conference on Multiphase Flow, ICMF'98, Lyon, France (June 1998).

Y. Hagiwara, H. Hana, M. Tanaka and M.R. Maxey, 1998. A numerical simulation on the heat transfer attenuation due to tangled polymers in a liquid turbulent channel flow, Proceedings of 11<sup>th</sup> International Heat Transfer Conference Vol 4, Kyongju, Korea (August 1998).

M.R. Maxey, 1999. Examples of fluid-particle interactions in dispersed two-phase flow, AIAA Paper 99-3691.

D. Liu, M. Maxey and G.E. Karniadakis, 2001. A fast algorithm for particulate micro-flows in complex geometries. Proceedings of 2001 ASME International Mechanical Engineering Congress and Exposition, New York, N.Y. (November 2001).

S. Dong, D. Liu, M.R. Maxey and G.E. Karniadakis, 2003. Fast methods for colloidal microdevices. AIAA paper 2003-0437. 41<sup>st</sup> Aerospace Sciences Meeting & Exhibit, Reno, Nevada, January 6-9 2003.

J. Xu, M.R. Maxey and G.E. Karniadakis, 2003. DNS of turbulent drag reduction using micro-bubbles. AIAA paper 2003-1280. 41<sup>st</sup> Aerospace Sciences Meeting & Exhibit, Reno, Nevada, January 6-9 2003.

D. Liu, M.R. Maxey and G.E. Karniadakis, 2003. Simulation and optimization of colloidal micropumps. Proc. 6<sup>th</sup> International Conference on Modeling and Simulation of Microsystems, San Francisco, Feb. 23-27, 2003.

M.R. Maxey, J. Xu, S. Dong and G.E. Karniadakis, 2003. Simulations of turbulent drag reduction using micro-bubbles. Proc. 4<sup>th</sup> Symposium on Smart Control of Turbulence, University of Tokyo, Japan, March 2-4, 2003.

D. Liu, M. Maxey, and G.E. Karniadakis, 2003. FCM-spectral element method for simulating colloidal micro-devices. Proc. of 2<sup>nd</sup> MIT Conference on Computational Fluid and Solid Mechanics, June 17-20, 2003, edited by K.J. Bathe. Elsevier

M.R. Maxey, J. Xu, S. Dong and G.E. Karniadakis, 2003. Simulation results for micro-bubbles and turbulent drag reduction. Proc. FEDSM'03, 4<sup>th</sup> ASME-JSME Joint Fluids Engineering Conference, Honolulu, Hawaii, USA, July 6-11, 2003. (FEDSM2003-45638)

M.R. Maxey, S. Dong, D. Liu, and J. Xu, 2003. Simulation of particulate flows with the force-coupling method. Proc. FEDSM'03, 4<sup>th</sup> ASME-JSME Joint Fluids Engineering Conference, Honolulu, Hawaii, USA, July 6-11, 2003. (FEDSM2003-45713)

D. Liu, M. Maxey, and G. E. Karniadakis, "An Efficient Algorithm for Simulating Micro-Colloidal Devices", *Abstracts of Seventh U.S. National Congress on Computational Mechanics*, July 28-30, 2003, Albuquerque, New Mexico.

M. Maxey, D. Liu, G. E. Karniadakis and E. Climent, 2004. Self-Assembled Particle Structures for Microflow System. 5<sup>th</sup> International Conference on Multiphase Flow – ICMF2004, Paper no. K02, May 30-June 4, 2004, Yokohama, Japan.

E. Climent and M.R. Maxey, 2004. Settling and instability of bidisperse suspensions. 5<sup>th</sup> International Conference on multiphase Flow – ICMF04, Paper no. 496, May 30-June 4, 2004, Yokohama, Japan.

M. R. Maxey, D. Liu, S. Dong, G. E. Karniadakis, 2004. New Advances in Force-Coupling Method: from micro to Macro. IUTAM Symposium on Computational Approaches to Disperse Multiphase Flow, October 4-7, 2004. Argonne National Laboratory, Argonne, Illinois.

D. Liu, M. Maxey, G. E. Karniadakis, 2004. Dynamic Self-Assembly in Micro-pipes: Effect of Net Flow. Proceedings of 2004 ECI conference: Transport Phenomena in Micro and Nano-devices, October 17-21, 2004, Kona, Hawaii.

D. Liu, M. Maxey, G. E. Karniadakis, 2004. Dynamic Self-Assembly in Confined Micro-Domains. Proceedings of 2004 ASME International Mechanical Engineering Congress and RD & D Exposition, November 13-19, 2004, Anaheim, California.

S. Dong, J. Xu, M.R. Maxey and G.E. Karniadakis, 2005. Slippery issues in microbubble drag reduction. AIAA paper 2005-23933. 43<sup>rd</sup> Aerospace Sciences Meeting & Exhibit, Reno, Nevada, January 2005.

J. Xu, S. Dong, M.R. Maxey and G.E. Karniadakis, 2005. Wall slippage effect in microbubble drag reduction. Proceedings of 2<sup>nd</sup> International Symposium on Seawater Drag Reduction, Busan, Korea, May 23-26, 2005.

S. Dong, J. Xu, M.R. Maxey and G.E. Karniadakis, 2005. Microbubble dynamics in turbulent channel flow. Proceedings of 2<sup>nd</sup> International Symposium on Seawater Drag Reduction, Busan, Korea, May 23-26, 2005.

M.R. Maxey, S. Dong, J. Xu and G.E. Karniadakis, 2005. Simulations for microbubble drag reduction (MBDR) at high Reynolds numbers. Proceedings of the HPCMP Challenge Project, Users Group Conference 2005, Nashville TN, June 27-30, 2005. (Published by IEEE Computer Society)

M.R. Maxey, D. Liu, E.E. Keaveny, G.E. Karniadakis and E. Climent, 2005. Dynamic self-assembly of paramagnetic beads for micro-devices. ASME International Mechanical Engineering Congress – Fluids Engineering Division, Orlando FL, November 5-11, 2005.

X. Luo, M.R. Maxey and G.E. Karniadakis, 2008. Smoothed particle method for particulate flows. ASME Paper FEDSM2008-55033, ASME 2008 Fluids Engineering Division Summer Conference, August 10-14, 2008, Jacksonville, FL, USA.

M.R. Maxey and K. Yeo, 2011. Flow Modulation by Finite Size Particles: From Stokes Suspensions to Turbulence. AIAA Paper 1103293. Sixth AIAA Theoretical Fluid Dynamics Conference, 41<sup>st</sup> AIAA Fluid Dynamics Conference & Exhibit and 20<sup>th</sup> AIAA Computational Fluid Dynamics Conference, 27-30 June, 2011, Honolulu, Hawaii.

N. Trask, M. Maxey, K. Yang, X. Hu, and J. Xu, 2013. Accuracy and performance of implicit projection methods for transient viscous flows using SPH. 8<sup>th</sup> International SPHERIC Workshop, Trondheim, Norway, June 4-6, 2013.

### **Papers read (last six years)**

May 2016, Ninth International Conference on Multiphase Flow (ICMF 2016), Florence, Italy, May 22-27. Paper:

A. Howard, M. Maxey and K. Yeo, “Particle fluxes and irreversibility due to shear flow in a bidisperse suspension”

July 2016, SIAM Conference on the Life Sciences, Boston, MA, July 11-14. Paper:

V. Kilikian and M. Maxey, “Chemotactic Response Models for Motile Bacteria”

November 2016, 69<sup>th</sup> Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Portland, OR. Paper:

A. Howard and M.R. Maxey, “Development of wall layering in non-homogenous suspension shear flows” (MS113)

N. Trask, M. Maxey, A.M. Tartakovsky, W. Pan and G.E. Karniadakis, “Particle Methods for the Mesoscale” (PP104)

SIAM conference on Computational Science and Engineering (CSE), Atlanta GA, February 27- March 3, 2017.

A. Howard, N. Trask and M. Maxey, “Simulations of Viscous Suspension Flows with a Meshless MLS Scheme”

18th International Workshop on Numerical Methods in Non-Newtonian Flows and 3rd Complex Fluids and Flows in Industry and Nature workshop at UBC, Vancouver, Canada, 12-16th June 2017. Paper:

A. Howard and M. Maxey, “Simulations of suspension flows with a meshless MLS scheme”

Supercomputing 2017 (SC17), November 12-17, 2017; Denver, CO. Amanda Howard, Martin Maxey and Nathaniel Trask – “Implementation of a meshless MLS scheme for simulations of suspension flows” (Poster presentation, Women in HPC session).

November 19-21, 2017, 70<sup>th</sup> Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Denver, CO. Paper:

A. Howard and M.R. Maxey, “Particle dispersion and segregation in suspension flows with bidispersed particle sizes” (M36.07)

November 23-26, 2019, 72<sup>nd</sup> Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Seattle, WA. Paper:

F. Vereda, N. Ionkin, A.A. Howard, M. Maxey, and D. Harris, “Shear-induced migration of a suspension under planar confinement” (B04.01)

June 19-24, 2022, 19th U.S. National Congress on Theoretical and Applied Mechanics (USNCTAM2022) in Austin, Texas. Paper:

M.R. Maxey and A. Howard, “Force coupling method for particle-laden flows and recent applications” (MS-217)

### **Invited lectures** (last six years)

IMA Conference on Turbulence, Waves and Mixing In Honour of Lord Julian Hunt’s 75th Birthday, July 6-8, 2016, King’s College, Cambridge, UK. Title: “Particulate flows at finite Reynolds numbers”

Euromech Colloquium 596 – Numerical simulations of flows with particles, bubbles and droplets. May 9-11, 2018, Venice Italy. Paper: A. Howard, M. Maxey, “*Particle dispersion and segregation in suspension flows with bidispersed particle sizes*”

The 15th International Conference for Mesoscopic Methods in Engineering and Science, July 9-13, 2018, University of Delaware. Presentation: “Simulation Methods for Particulate Flows and Concentrated Suspensions”

International Centre for Theoretical Sciences of the Tata Institute Fundamental Research (ICTS-TIFR), Bangalore. Meeting on "Sediment Transport in the Ocean and Droplet Transport in Clouds" scheduled to be held from September 14 -18, 2020. Lectures: “Theory of particle motion in fluids”. Meeting cancelled due to COVID.

IUTAM Conference, “From Stokesian suspension dynamics to particulate flows in turbulence”, August 29 – September 2, 2022, IMFT, Toulouse, France.

Symposium in honor of Professor Said Elghobashi, September 15, 2022, Beckman Institute, Irvine CA.

### **Work in progress**

K. Zhang, Z. Li, M.R. Maxey and G.E. Karniadakis. Nucleation of cavitation bubbles on hydrophobic particles.

## **Research Grants**

### **Current awards**

Department of Energy – Award, October 2018 – September 2022, \$1,200,000 (co-investigator for award to Brown University), " PhILMs: Collaboratory on Mathematics and Physics-Informed Learning Machines for Multiscale and Multiphysics Problems" This is part of a collaborative lead by G. Karniadakis (Director) involving DoE's PNNL and SNL, with Brown, MIT, Stanford, and UCSB.

Department of Energy – Award DE-SC0023191, October 2022 – September 2026, \$2,000,000. “SEA-CROGS: Scalable, Efficient and Accelerated Causal Reasoning Operators, Graphs and Spikes for Earth and Embedded Systems”. Principal investigator for award to Brown University. Collaborative project lead by G. Karniadakis (Director) involving DoE's PNNL and SNL, with Brown, Yale, NJIT and Stanford.

### **Completed awards**

National Science Foundation - ATM8310136, Nov. 1984 - Feb. 1988. “Study of the fallout and dispersion of particles in turbulence and random fields”

National Air and Space Administration, with L.Sirovich, 1986-1987. “Problems in fluid dynamics”

DARPA, University Research Initiative, L. Sirovich-Director, Oct. 1986 - March 1992. “Analysis, Prediction and Control of Turbulent Flows”

DoD, DURIP equipment grant for computer systems, (with L. Sirovich, E. Meiburg). Oct. 1988 - Sept. 1989.

Office of Naval Research - ARI on Dynamics of Bubbly Flows, Nov. 1990-Oct. 1993. “The dynamics of bubbly flows and the modification of turbulence by microbubbles”

National Science Foundation - DMS 9205227, Sept. 1992-Feb. 1994, Principal Investigator (Co-P.I.'s, C. Jones, D. McClure, L. Sirovich). "Mathematical Sciences Computing Research Environments"

Office of Naval Research - ARI on Dynamics of Bubbly Flows, Nov. 1993-April 1996. "The dynamics of bubbly flows and the modification of turbulence by microbubbles"

National Science Foundation - STI-9413819, Academic Research Infrastructure Program. Co-P.I. (P.I. G. Karniadakis), Oct. 1994-Sept. 1995. "Acquisition of a parallel supercomputer"

National Science Foundation - CTS9424169 - Fluid, Particulate and Hydraulic Systems Program, May 1995-April 1998, \$218,723. "Interactions of finite-sized particles and turbulence in dispersed two-phase flow"

National Science Foundation - DMS9628601, (with G. Karniadakis, D. Gottlieb, C. Jones and D. McClure), Aug. 1996-July 1997, \$40,000. "Mathematical Sciences Computing Research Environments"

National Science Foundation - CTS9619232 - Fluid, Particulate and Hydraulic Systems Program, Co-P.I. (P.I. G. Karniadakis), Sept. 1997 - Aug. 1998, \$60,000. "A new model for turbulence based on the hydrodynamics - electromagnetism analogy"

National Center for Microgravity Research, USRA 4500-03, Sept. 1998- Oct. 1999, \$39,675. "Initial investigation of particle interactions and dispersed two-phase flow under low gravity conditions"

DARPA, ATO – Friction Drag Technologies Program, MDA972-01-C-0024, March 2001 – September 2003, \$928,858 (\$671,521 at Brown University). P.I., with G. Karniadakis and B. Caswell co-PI's at Brown University. "Microbubble and microbubble/polymer turbulent drag reduction"

DARPA, ATO – Friction Drag Technologies Program, subcontract through ARL – Penn State Univ., November 2003 – June 2006, \$499,448. P.I. (co-P.I. G. Karniadakis) at Brown University. "Multiscale physical modeling for micro-bubble drag reduction at high Reynolds numbers" (RFP 04-15)

National Science Foundation – CTS 0326702 - Particulate and Multiphase Processes Program, Jan 2004 – Dec 2007, \$307,968. P.I. (co-P.I. G. Karniadakis) "Simulation of Magnetorheological Fluids: Microdevices and Self-Assembled Structures"

National Science Foundation – DMS 0506312 - Multiscale Modeling: BBB, Sep 2005 – Aug 2009, \$640,475. Co-P.I. (P.I. G.E. Karniadakis and co-P.I. P.D. Richardson) "A Stochastic Molecular Dynamics Method for Multiscale Modeling of Blood Platelet Phenomena"

National Science Foundation – DUE 0734234 – Div. of Undergraduate Education, Oct 2007 – Sep 2011, \$235,000. P.I. (co-P.I.'s: C. Lawrence, G. Karniadakis, P.D. Richardson, J.X. Tang). UBM-Group: Undergraduate Training and Research in Applied Mathematics and Biological Sciences.

National Science Foundation – 1133106 CBET: Particulate and Multiphase Processes Program, Sep 2011 – Aug 2015, \$333,976. P.I. (co-P.I.A. Tripathi, Engineering) “Dispersion in Microfluidic Suspensions: Experiments and Numerical Simulations” REU supplement, \$5,400 was awarded May 21, 2013.

Department of Energy – Award DE-SC0009247, Dec 2012 – May 2018, \$1,500,000 (PI for award to Brown University), "Modeling mesoscale processes of scalable synthesis" This is part of a collaborative award for Mathematics for Mesoscopic Modeling of Materials (CM4) lead by G. Karniadakis (Director) involving DoE's PNNL and SNL, with Brown, Princeton, PSU, Stanford, U. Minnesota, UCSB.

## **Service**

### **Service to the University** (last 10 years)

- Director, Center for Fluid Mechanics, Turbulence and Computation (1991-2020)
- Member – Brown University Faculty Executive Committee, January-June 2010
- Various departmental committees in the Division of Applied Mathematics and the School of Engineering for tenure and promotion and faculty searches
- Chair, Computer Committee, Division of Applied Mathematics (Sept 2009 – June 2011)
- Library representative, Division of Applied Mathematics (July 2011 – December 2012)
- Undergraduate Committee and Concentration Advisor – Applied Mathematics (September 2013 – May 2017; September 2018 – June 2022)
- Director for undergraduate teaching assistants in Applied Mathematics (Fall 2017, Spring & Fall 2019, Spring 2020 – Fall 2021)
- Member – Brown University Conflict of Interests Review Board (November 2014 – December 2021)

### **Service to the profession** (last 10 years)

- Corrsin Award Committee, Division of Fluid Dynamics, American Physical Society. Vice-Chair 2011 and Chair 2012
- Local organizing committee, 68<sup>th</sup> Annual Meeting of American Physical Society, Division of Fluid Dynamics, November 2015.
- Editorial Advisory Board, International Journal of Multiphase Flow, 1997 - 2010.
- Associate editor, Fluid Dynamics Research, January 2009 –December 2010

- Editor, Fluid Dynamics Research, January 2011 – December 2019
- Editorial Committee for Annual Review of Fluid Mechanics, Volume 52 (2020)
- Scientific Committee, Intl. Conf. Multiphase Flow, Tampa FL, May 30 – June 4, 2010
- Co-organizer, mini-symposium MS212: Hydrodynamic Stability and Simulation of Complex Fluid Flows in Porous Media. 19th U.S. National Congress on Theoretical and Applied Mechanics, June 19-24, 2022, in Austin, Texas.
- Conference chairman, IUTAM Conference, “From Stokesian suspension dynamics to particulate flows in turbulence”, August 29 – September 2, 2022, IMFT, Toulouse, France.
- Referee for National Science Foundation, US - Israel Bi-national Science Foundation, Swiss National Science Foundation, Petroleum Research Fund, Department of Energy, NASA
- Referee for the Journal of Fluid Mechanics, Physics of Fluids, International Journal of Multiphase Flow, ASME Journal of Fluids Engineering, Journal of the Atmospheric Sciences, Journal of Marine Research, Physical Review E, Physical Review Letters, Quarterly of Applied Mathematics, Journal of Computational Physics, Theoretical & Computational Fluid Dynamics, Fluid Dynamics Research and other journals.
- Referee for external tenure and promotion reviews in the area of fluid mechanics.

Member: American Geophysical Union; American Physical Society; American Society of Mechanical Engineers; Society for Industrial and Applied Mathematics; Society of Rheology; Sigma Xi.

## 8. Academic awards

Fellow, American Physical Society, elected September 2005.

Japan Society for the Promotion of Science, Invited Research Fellow, 1997.

Rayleigh Essay Prize, University of Cambridge, 1977.

Research Scholarship and College Prize, Trinity Hall, Cambridge, 1975.

Scholarship and College Prize, Trinity Hall, Cambridge, 1972 and 1973.

## 9. Teaching (last six years)

2016-2017

Fall: APMA 1930P Senior seminar: Mathematics and Climate (7 students)

Spring: APMA 2420/ENGN 2820 Fluid Dynamics II (6 students)

Spring: APMA 2980 Research in Applied Mathematics (1 student)

Ph. D. student advisees: 2  
Sc.M. thesis advisee: 1  
Freshmen advisees: 5  
Sophomore advisees: 6  
Concentration advisees: 10

2017-2018

Fall: APMA 0360 Applied Partial Differential Equations I (53 students)  
Fall: APMA 1970 Independent Study (2 students)  
Spring: On sabbatical leave  
Spring: APMA 1970 Independent Study (2 students)  
Ph. D. student advisees: 1  
Sophomore advisees: 5  
Concentration advisees: 8

2018-2019

Fall: APMA 1930P Senior seminar: Mathematics and Climate (25 students)  
Spring: APMA 0360 Applied Partial Differential Equations I (33 students)  
Spring: APMA 1970 Independent Study (1 student)  
Concentration advisor

2019-2020

Fall: APMA 0360 Applied Partial Differential Equations I (55 students)  
Spring: APMA 2420/ENGN 2820 Fluid Dynamics II  
Concentration advisor

2020-2021

Fall: APMA 1970 Independent Study (1 student)  
Spring: APMA 0360 Applied Partial Differential Equations I  
Summer: APMA 0330 Methods of Applied Mathematics I  
Concentration advisor  
First-year advisor

2021-2022

Fall: APMA 0360 Applied Partial Differential Equations I  
Concentration advisor  
Sophomore advisor

## **10. Ph.D theses supervised**

S. Balachandar. Particle coagulation in homogeneous turbulence (January, 1988).

H. Shin. Chaotic Sedimentation of nonspherical particles (May, 1990).

G. Ruetsch. The structure and dynamics of the vorticity and passive scalar fields at small scales in homogeneous isotropic turbulence (June, 1991).

R. Mallier. Weakly nonlinear waves in mixing layers (September, 1991).

D. Mello. The stability of oscillatory flow in a circular pipe (December, 1991).

R. Katz. Transitions to turbulence: determinism in nature (February, 1992).

E. Chang. Accelerated motion of rigid spheres in unsteady flow at low to moderate Reynolds numbers (April, 1992).

B. Patel. Problems in turbulence and two-phase flow (May, 1996).

M. Stephens. A one-dimensional mixed-layer ocean model for use in three-dimensional climate simulations (Nov, 1997. Supervised in collaboration with Professor T. Webb, Dept of Geological Sciences.)

G. Dent. Aspects of particle sedimentation in dilute flows at finite Reynolds numbers (May, 1999).

S. Dance. Particle sedimentation in viscous fluids (May, 2002).

D. Liu. Simulations of dispersed two-phase flows (May 2004). (Supervised in collaboration with G. Karniadakis)

J. Xu. Turbulent drag reduction by injection of microbubbles (May, 2005). (Supervised in collaboration with G. Karniadakis)

E. Keaveny. Dynamics of structures in active suspensions of paramagnetic particles and applications to artificial micro-swimmers (May 2008).

Kyong-Min Yeo. Some aspects of suspension flows: Stokes to turbulent flows (May 2011)

Nathaniel Trask. Compatible high-order meshless schemes for viscous fluid flows through  $\ell_2$  optimization (December 2015)

Virginia Eirini Kilikian. Chemotactic response models for motile bacteria (January 2017)

Amanda Howard. Numerical simulations to investigate particle dispersion in non-homogeneous suspension flows (May 2018)