Curriculum Vitae

Roberto ZENIT

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1 Personal Information

- **Complete birth name:** José Roberto Zenit Camacho
- **Place and date of birth:** Ciudad de México, D.F., June 7th, 1969.
- **Nationality:** Mexican, US permanent resident.
- Married, two children.

2 Research Interests

- Fluid Mechanics: two-phase flows, granular flows, biological flows
- Rheology
- Heat transfer

3 Education

1. Licenciatura (B.Sc.), Ingeniería Mecánica y Eléctrica, Facultad de Ingeniería, Universidad Nacional Autónoma de México, 1992. With Honors.
2. Master (M.Sc.), Mechanical Engineering Department, California Institute of Technology, 1993.
3. Doctorate (Ph.D.), Mechanical Engineering Department, California Institute of Technology. Advisor: Professors Melany L. Hunt and Chris E. Brennen, 1997

4 Professional Appointments

1. Undergraduate Research Assistant, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, 1990 to 1992.

2. Graduate Research and Teaching Assistant, Mechanical Engineering Department, California Institute of Technology, 1993 to 1997.

3. Postdoctoral Scholar, Mechanical Engineering Department, California Institute of Technology, 1997.

4. Postdoctoral Associate, School of Chemical Engineering, Cornell University, 1998 to 1999.

5. Investigador Asociado 'C'. (Assistant Professor), Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de Mexico, 1999 to 2001.

6. Investigador Titular 'A'. (Associate Professor), Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de Mexico, 2001 to 2005. Tenured position since August of 2003.

7. Investigador Titular 'B'. (Associate Professor), Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de Mexico, 2005 to 2010.

8. Investigador Titular 'C'. (Full Professor), Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de Mexico, from April of 2010 to June 2019.

9. Professor of Engineering, School of Engineering, Brown University, since July 2019.

5 Teaching and Student Advise

- **Thesis director:** 35 undergraduate, 17 master and 11 doctoral thesis. I have also supervised 11 postdoctoral researchers. Current group: 5 PhD students, 1 Master student and 2 undergraduate students.
- **Thesis committee service:** member of 78 thesis committees (38 PhD level)
- **Teaching:** instructor for 45 courses at undergraduate level and 23 courses at graduate level.

5.1 Posdoctoral Associates

1. Celine Goujon, Movimiento de burbujas en medios no newtonianos y avalanchas granulares. 2005 to 2007. Current position: Instructor, College L´Estaque, Marsella, Francia
2. Santos Mendez Dias, Flujos burbujeantes. 2008 to 2010. Current position: Associate Professor, Universidad Autónoma de Nuevo Leon, México.
3. J. Enrique Guzmán, Flujo multifásicos y Flujo a través de válvulas cardiacas. 2010 to 2011. Current position: Researcher/Assistant Professor, Instituto de Ingeniería, UNAM.
4. Francisco Antonio Godinez Rojano, Nado de microorganismos. 2011 to 2014. Current position: Researcher/Assistant Professor, Instituto de Ingeniería, UNAM.
5. Alberto Beltran Morales, Flujo a través de válvulas cardiacas. 2013 to 2014. Current position: Researcher/Assistant Professor, Instituto de Investigaciones en Materiales, UNAM.
6. Oscar Arturo Chávez López, Flujo a través de medios porosos. 2011 to 2014. Current position: Assistant Professor, Instituto Tecnológico de Chihuahua.
7. Elsa Maria de la Calleja Mora, Flujo a través de medios porosos con geometría fractal. 2013 to 2014. Current position: Research Associate, IIM-UNAM.
8. Raphael Poryles, Rheology of art. 2017 to 2018. Current position: Postdoctoral scholar, France.
9. Jorge Gonzalez-Gutierrez, The motion of microorganisms across interfaces. 2018 to 2019. Current position: Assistant Professor, Universidad Autonoma de Chiapas, Mexico.
10. Yunxing Su, Dynamics of coiling filaments. 2019 to 2021. Current position: Posdoctoral scholar, Brown University.

5.2 Ph.D. students

1. José Ramón Herrera Velarde, *Transferencia de calor en flujos viscoelásticos oscilatorios. Aplicación a boquillas oscilantes de extrusión.*, División de Estudios de Posgrado de la facultad de Ingeniería, Universidad Nacional Autónoma de México, Co-advised with: Prof. B. Mena, April 2000. Current position: Researcher, Instituto de Investigaciones Eléctricas.
2. Gustavo Joseph González, *Collisional dynamics of macroscopic particles in a viscous fluid.* Mechanical Engineering Department, California Institute of Technology. Co-advised with: Prof. M.L. Hunt, May 2003. Current position: Sr. Thermal Engineer, Tessera Inc.
3. Bernardo Figueroa Espinoza, *Clustering in bubbly liquids*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, August 2006. Current position: Researcher/Associate Professor, Instituto de Ingeniería (Unidad Mérida), UNAM.

4. Enrique Soto Castruita, *Flow of single air bubbles in complex fluids*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, Co-adviced with: Prof. O. Manero, January 2008. Current position: Researcher, Instituto Mexicano del Petroleo.

5. Alicia Aguilar Corona *Agitation des particules dans un lit fluidisé liquide. Etude expérimentale.* Laboratoire de Génie Chimique - UMR 5503 - CNRS/INP/UPS, Francia. Co-advised with: Prof. O. Masbernat, December 2008. Current position: Researcher/Associate Professor, Universidad Michoacana de San Nicolas Hidalgo.

6. Carlos Alberto Palacios Morales, *Dynamics of non-newtonian vortex rings*, Facultad de Ingeniería, Universidad Nacional Autónoma de México, September 2010. Current position: Assistant Professor, Facultad de Ingeniería, UNAM.

7. Rodrigo Vélez Cordero, *Study of the properties of bubble flows in non-newtonian fluids*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, April 2011. Current position: Researcher/Assistant Professor, Universidad Autonoma de San Luis Potosi, Mexico.

8. Horacio Tapia McClung, Colapsos de columnas granulares, Facultad de Ingeniería, Universidad Nacional Autónoma de México, December 2012. Current position: Researcher, Universidad Veracruzana, Veracruz Mexico.

9. Fabio Ernesto Mancilla Ramos, *Caracterización de un flujo bifásicos en tanques de mezclado*, Facultad de Ingeniería, Universidad Nacional Autónoma de México, March 2015. Current position: Postdoc, Curitiba, Brazil.

10. Lamberto Díaz Damacillo, *Movimiento de burbujas en medios estratificados*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, October 2016. Current position: Teaching post in Guerrero, Mexico.

11. Christophe Barbosa, *Interacción de burbujas con paredes*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, December 2016. Current position: Researcher, IRPHE, France.

12. Rogelio Valdés Herrera, *Locomoción en medios granulares*, Facultad de Ingeniería, Universidad Nacional Autónoma de México, October 2020.

13. Veronica Angeles, *Locomocion de microorganismos a traves de interfases*, Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, February 2022.

14. Asimanshu Das, *Fluid-structure interactions is swimming at low Reynolds numbers* School of Engineering, Brown University, August 2022.

15. Victor Cárdenas, *The performance of prosthetic heart valves at high frequencues*, Facultad de Ingeniería, Universidad Nacional Autónoma de México, on leave.

16. Andres Zambrano, *Swimming of microorganisms in complex media*, School of Engineering, Brown University, to graduate in 2023.

17. Madeline Federle, *Bubble-droplet interactions in microgravity*, School of Engineering, Brown University, to graduate in 2024.

18. Mithun Ravisankar, *Hydrodynamic interactions in non Newtonian liquids*, School of Engineering, Brown University, to graduate in 2025.

19. Avery Trevino, *Glymphatic fluid mechanics*, School of Engineering, Brown University, to graduate in 2027.

6 Publications

119 publications refereed archival journals ; 20 extended abstracts in refereed conference proceedings; 3 book chapters. Cited: 2764 times, H-index = 30 (according to Scopus, excluding self citations); 3973 times, H-index = 31 (according to Google Scholar). Author of three patents.

6.1 Publication list

1. Zenit, R., Hunt, M.L. and Brennen, C.E., Collisional particle pressure measurements in solid-liquid flows, *Journal of Fluid Mechanics*, **353**, 261–283, 1997.

2. Zenit, R., Hunt, M.L. and Brennen, C.E., On the direct and radiated components of the particle pressure in liquid-solid flows, *Applied Scientific Research*, **58**, 305–317, 1998.

3. Zenit, R. and Hunt, M.L., The impulsive motion of a liquid resulting from a particle collision, *Journal of Fluid Mechanics*, **375**, 345–361, 1998.

4. Zenit, R. and Hunt, M.L., Mechanics of immersed particle collisions, *Journal of Fluids Engineering*, **121**, 1999, 179–184.

5. Zenit, R. and Hunt, M.L., Solid fraction fluctuations in solid-liquid flows, *International Journal of Multi-Phase Flow*, **26**, 763–781, 2000.

6. Hernandez-Cordero J., Zenit, R., Geffroy, E., and Mena, B., Experiments on granular flow in a hexagonal silo; a design that minimizes dynamic stresses, *Korea-Australia Journal of Rheology*, **12**, 269–281, 2000.

7. Zenit, R., Koch, D.L. and Sangani, A.K., Measurements of the average properties of a suspension of bubbles rising in a vertical channel, *Journal of Fluid Mechanics*, **429**, 307-342, 2001.

8. Joseph, G.G., Zenit, R., Hunt, M.L. and Rosenwinkel, A., Particle-wall collisions in a viscous fluid , *Journal of Fluid Mechanics*, **433**, 329 - 346, 2001.

9. Chavez, B.E., Galicia, O.M., Geffroy, E., Zenit, R. and Mena, B. Grain Drying and Aeration in a New Solar Hexagonal Silo, *Particulate Science and Technology*, **19**, 45-65, 2001.

10. Herrera-Velarde, J.R., Zenit, R. and Mena, B., Viscous dissipation of a power law fluid in an oscillatory pipe flow, *Revista Mexicana de Física*, **47**, 351-356, 2001.

11. Hunt, M.L., Zenit, R. Campbell, C.S. and Brennen, C.E., Revisiting the 1954 suspension experiments of R. A. Bagnold, *Journal of Fluid Mechanics*, **452**, 1-24, 2002.

12. Herrera-Velarde, J.R., Zenit, R. and Mena, B., Measurement of the temperature rise in non-Newtonian oscillatory pipe flows, *Journal of Non-Newtonian Fluid Mechanics*, **109**, 157-176, 2003.

13. Herrera-Velarde, J.R., Zenit, R., Chehata, D. and Mena, B., The flow of non-Newtonian fluids around bubbles and its connection to the jump discontinuity, *Journal of Non-Newtonian Fluid Mechanics*, **111**,199–209, 2003.

14. Zenit, R., Koch, D.L. and Sangani, A.S., Impedance probe to measure local gas volume fraction and bubble velocity in a bubbly liquid, *Review of Scientific Instruments*, **74**, 2817–2827, 2003.

15. Lima-Ochoterena and Zenit, R., Visualization of the flow around a bubble moving in a low viscosity liquid, *Revista Mexicana de Física*, **49**, 348–352, 2003.

16. Chehata, D., Zenit, R. and Wassgren, C.R., Dense granular flow around an immersed cylinder, *Physics of Fluids*, **15**, 1622–1631, 2003.

17. Wassgren, C.R., Cordova, J.A. Zenit, R. and Karion, A., Dilute granular flow around an immersed cylinder, *Physics of Fluids*, **15**, 3318–3330, 2003.

18. Arroyo-Cetto, D., Pulos, G., Zenit, R. and Wassgren, C.R., Compaction force in a confined granular column, *Physical Review E.*, **68**, 051301, 2003.

19. Zenit, R., Tsang, Y.H., Koch, D.L. and Sangani, A.S., Shear flow of a suspension of bubbles rising in an inclined channel, *Journal of Fluid Mechanics*, **515**, 261 - 292, 2004.

20. Zenit, R., Computer simulations of the collapse of a granular column, *Physics of Fluids*, **17**, 031703, 2005.

21. Herrera-Velarde, J.R., Mena, B. and Zenit, R., Propiedades mecánicas del producto extrudido de un flujo viscoelastico oscilante, *Ingeniería Mecánica, Tecnología y Desarrollo*, **1**, 202–208, 2005.

22. Figueroa-Espinoza, B.. and Zenit, R., Clustering in high *Re* monodispersed bubbly flows, *Physics of Fluids*, **17**, 091701, 2005.

23. Moctezuma, M., Lima-Ochoterena, R. and Zenit, R., Velocity fluctuations resulting from the interaction of a bubble with a vertical wall, *Physics of Fluids*, **17**, 098106, 2005.

24. Bharadwaj, R., Wassgren, C.R and Zenit, R., The unsteady drag force on a cylinder immersed in a dilute granular flow, *Physics of Fluids*, **18**, 043301, 2006.

25. Legendre, D., Zenit, R., Daniel, C. and Guirand, P. A note on the modelling of the bouncing of spherical drops or solid spheres on a wall in viscous fluid, *Chemical Engineering Science*, **61**, 3543 – 3549, 2006.

26. Soto, E., Goujon, C., Zenit, R. and Manero, O. A study of velocity discontinuity for single air bubbles rising in an associative polymer, *Physics of Fluids*, **18**, 121510, 2006.

27. Charru, F., Larrieu, E., J.-B., Dupont and Zenit, R., Motion of a particle near a rough wall in a viscous shear flow, *Journal of Fluid Mechanics*, **570**, 431-453, 2007.

28. Dominguez, H. and Zenit, R. On the cooling law of a non-dilute granular gas. *Revista Mexicana de Física*, **53**, 83-86, 2007.

29. Linares-Guerrero, E., Goujon, C., and Zenit R. Increased mobility of bi-disperse granular avalanches. *Journal of Fluid Mechanics*, **593**, 475-504, 2007.

30. Martinez-Mercado, J., Palacios-Morales, C.A. and Zenit, R. Measurement of pseudoturbulence intensity in monodispersed bubbly liquids for 10<Re<500. *Physics of Fluids*, **19**, 103302, 2007.

31. Martin, R. and Zenit, R. Heat transfer resulting from the interaction of a vortex ring with a heated wall. *Journal of Heat Transfer*, **130**, 051701, 2008.

32. Zenit, R. and Magnaudet, J. Path instability of rising spheroidal air bubbles: a shape-controlled process. *Physics of Fluids*, **20**, 061702, 2008.

33. Soto, E., Zenit, R. and Manero, O. Break up of the tail of a bubble in a non Newtonian fluid. *Physics of Fluids*,**20**, 091110, 2008.

34. Figueroa-Espinoza, B., Zenit, R. and Legendre, D. The effect of confinement on the motion of a single clean bubble. *Journal of Fluid Mechanics*, **616**, 419-443, 2008.

35. Zenit, R. and Magnaudet, J. Measurements of the streamwise vorticity in the wake of an oscillating bubble. *International Journal of Multiphase Flow*, **35**, 195-203, 2009.

36. Mendoza-Fuentes, A.J., Montiel, R., Zenit, R., Manero, O., On the flow of associative polymers past a sphere: Evaluation of negative wake criteria. *Physics of Fluids*, **21**, 033104, 2009.

37. Zenit, R. and Legendre, D. The coefficient of restitution for air bubbles colliding against solid walls in viscous liquids. *Physics of Fluids*, **21**, 083306, 2009.

38. Camacho-Martínez, J., Ramirez-Argaez, M., Zenit, R., Juárez-Hernández, A., Barceinas-Sánchez, O. and Trapaga, G., Physical modelling of an Aluminium degassing operation with rotating impellers –a comparative hydrodynamic analysis. *Materials and Manufacturing Processes*, **25**, 581-591, 2010.

39. Mendoza-Fuentes, A.J., Zenit, R., Manero, O., Evaluation of the drag correction factor for spheres settling in associative polymers. *Rheologica Acta*, **49**, 979–984, 2010.

40. Sanchez-Arevalo, F. M., Farfn, M., Covarrubias, D., Zenit, R. and Pulos, G. Micromechanical behavior of lyophilized glutaraldehyde-treated bovine pericardium under uniaxial tension. *Journal of the Mechanical Behavior of Biomedical Materials*, **3**, 640-646, 2010.

41. Solórzano-Lopez, J. , Ramirez-Argaez, M., Zenit, R. Modelado físico de la incidencia de un chorro de aire sobre una superficie de agua. *Revista de Metalurgia*, **46**, 405–420, 2010.

42. Vélez-Cordero, J.R. and Zenit, R. Bubble cluster formation in shear-thinning inelastic bubbly columns. *Journal of Non Newtonian Fluid Mechanics*, **166**, 32-41, 2011.

43. Vélez-Cordero, J.R., Sámano, D., Yue, P., Feng, J. J. and Zenit, R. Hydrodynamic interaction between a pair of bubbles ascending in shear-thinning inelastic fluids. *Journal of Non Newtonian Fluid Mechanics*, **166**, 118-132, 2011.

44. Guzman, J.E.V. and Zenit, R. Application of the Euler-Lagrange Method to Model Developed Hydrodynamic Slugs in Conduits. *Journal of Fluids Engineering*, **133**, 041301, 2011.

45. Solórzano-Lopez, J. , Ramirez-Argaez, M., Zenit, R. Mathematical and Physical Simulation of the Interaction between a Gas Jet and a Liquid Free Surface. *Applied Mathematical Modelling*, **35**, 2011, 4991–5005.

46. Aguilar-Corona, A., Zenit, R. and Masbernat, O., Collisions in a liquid fluidized bed. *International Journal of Multiphase Flow*, **37**, 695–705, 2011.

47. Pacheco, R., Ruiz-Angulo, A., Zenit, R. and Verzicco, R., Fluid velocity fluctuations in a collision of a sphere with a wall. *Physics of Fluids*, **23**, 063301, 2011.

48. Hidalgo-Millán, A. , Soto, E., Zenit, R. and Ascanio, G. Effect of eccentricity on the pumping capacity in an unbaffled vessel. *Canadian Journal of Chemical Engineering*, **89**, 1051–1058, 2011.

49. Lopez-Zazueta, A., Ledesma-Alonso, R. Guzman, J.E.V. and Zenit, R. Study of the velocity and strain fields in the flow through prosthetic heart valves. *Journal of Biomechanical Engineering*, **133**, 121003, 2011.

50. Mendez-Diaz, S., Zenit, R., Chiva, S., Munoz-Cobo, J.L., A criterion for the transition from wall to core peak gas volume fraction distributions in bubbly flows. *International Journal of Multiphase Flow*, **43**, 56–61, 2012.

51. Pimentel-Domínguez, R., Hernandez-Cordero, J., Zenit, R. Microbubble generation using fiber optic tips coated with nanoparticles. *Optics Express*, **20**, 8732-8740, 2012.

52. Legendre, D., Zenit, R. and Vélez-Cordero, J.R., On the deformation of gas bubbles in liquids. *Physics of Fluids*, **24**, 043303, 2012.

53. Vélez-Cordero, J.R., Samano, D. and Zenit, R. Study of the properties of bubbly flows in Boger-type fluids. *Journal of Non Newtonian Fluid Mechanics*, **175-176**, 1-9, 2012.

54. Tapia-McClung, H. and Zenit. R., Computer simulations of the collapse of columns formed by elongated grains. *Physical Review E*, **85**, 061304, 061304, 2012.

55. Godinez, F., Chávez, O. and Zenit, R. Design of a novel rotating magnetic field device. *Review of Scientific Instruments*, **83**, 066109, 2012.

56. Hidalgo-Millán, A.,Zenit, R., Palacios, C., Yatomi, R., Horiguchi, H., Tanguy, P.A. and Ascanio, G., On the hydrodynamic characterization of the straight Maxblend impeller with Newtonian fluids. *Chemical Engineering Research and Design*, **90**, 1117–1128, 2012.

57. Hidalgo-Millán, A., Taboada, B., Vega-Alvarado, L., Zenit, R., and Ascanio, G., Enhancement of laminar mixing in stirred vessels using off-centered impellers. *Journal of Applied Research and Technology*, **10**, 520–533, 2012.

58. Palacios-Morales, C.A. and Zenit R., Vortex ring formation for low Re numbers. *Acta Mechanica*, **224**, 383–397, 2013.

59. Palacios-Morales, C.A. and Zenit R., The formation of vortex rings in shear-thinning liquids. *Journal of Non Newtonian Fluid Mechanics*, **194**, 1–13, 2013.

60. Espinoza-Garcia, J., Lauga, E. and Zenit, R. Fluid elasticity increases locomotion of flexible swimmers. *Physics of Fluids*, **25**, 031701, 2013.

61. Ramos-Gómez, E., Zenit, R, Gonzalez-Rivera, C. Trapaga, G. and Ramirez-Argaez, M., Mathematical modeling of fluid flow in a water physical of an aluminum laddle equipped with impeller and gas purging for degassing. *Metallurgical and Material Transactions B*, **44**, 423–435, 2013.

62. Mendez-Diaz,S., Serrano-Garcia, J.C., Zenit, R. and Hernández-Cordero, J.A., Power spectral distributions of pseudo-turbulent bubbly flows. *Physics of Fluids*, **25**, 043303, 2013.

63. Sanchez-Arevalo, F.M., Tapia-McClung, H., Pulos, G. and Zenit, R., Reduction of compaction force in a confined bidisperse granular media. *Physical Review E*, **87**, 052210, 2013.

64. Ramos-Gómez, E., Zenit, R, Gonzalez-Rivera, C. Trapaga, G. and Ramirez-Argaez, M., Physical modeling of fluid flow of an aluminum laddle equipped with impeller and gas purging for degassing. *Metallurgical and Material Transactions B*,**44 B**, 974–983, 2013.

65. Ledesma-Alonso, R., Guzman, J.E.V. and Zenit, R., Experimental study of a model valve with flexible leaflets in a pulsatile flow. *Journal of Fluid Mechanics*, **739**, 338–362, 2014.

66. Arco, R.M., Velez-Cordero, J.R., Lauga, E. and Zenit R., Viscous pumping inspired by flexible propulsion. *Biomimmetics and Bioinspiration*, **9**, 036007, 2014.

67. Velez-Cordero, J.R., Lantenet, J., Hernández-Cordero, J.A. and Zenit R. Compact bubble clusters in Newtonian and non-Newtonian liquids. *Physics of Fluids*, **26**, 053101, 2014.

68. Chavez, O., Godinez, F., Beltrán, A., Garcia, A. and Zenit, R. Conjugate thermo-electric model for a two-phase porous media. *PLOS ONE*, **9(5)**, e97895, 2014.

69. Palacios-Morales, C., Gelderblom, G., Solorio, F., Salinas-Vazquez, M. and Zenit, R., Interaction of a vortex ring with a natural convective layer. *Physics of Fluids*, **26**, 083602, 2014.

70. de la Calleja, E., Zetina, S. and Zenit R. Rayleigh-Taylor instability creates provocative images in painting. *Physics of Fluids*, **26**, 091102, 2014.

71. Godinez, F., de la Calleja, E., Lauga E. and Zenit, R., Sedimentation of a rotating sphere in a power-law fluid. *Journal of Non Newtonian Fluid Mechanics*, **213**, 27–30, 2014.

72. Mancilla, E., Palacios-Morales, C.A., Córdova-Aguilar, M.S., Trujillo-Roldán, M.A., Ascanio, G., Zenit, R. , A hydrodynamic description of the flow behavior in shaken flasks. *Biochemical Engineering Journal*, **99**, 61-66, 2015.

73. Zetina, S. Godinez, F.A. and Zenit, R. A hydrodynamic instability is used to create aesthetically appealing patterns in painting. *PLOS ONE*, **10**, e0126135, 2015.

74. Godinez, F., Koens, L., Montenegro-Johnson, T.D., Zenit, R. and Lauga E. Complex fluids affect low-Reynolds number locomotion in a kinematic-dependent manner, *Experiments in Fluids*, **56**, 97, 2015.

75. Sanjuan-Galindo, R., Soto, E., Zenit, R. and Ascanio, G. Viscous filament fragmentation in a turbulent flow inside a stirred tank. *Chemical Engineering Communications*, **25**, 1251-1260, 2015.

76. Palacios-Morales, C.A., Barbosa, C., Solorio, F. and Zenit R., Negative vortices: The formation of vortex rings with reversed rotation in viscoelastic liquids. *Physics of Fluids*, **27**, 051703, 2015.

77. Hernandez-Badillo, C., Guzman, J.E.V. and Zenit, R., Effect of the Curvature of Elastic Plates on the Evolution of Pulsatile Flow fields. *Journal of Fluids and Structures*, **56**, 177–189, 2015

78. Godinez, F., Chavez, O., Garcia, A. and Zenit, R. A space-fractional model of thermo-electromagnetic wave propagation in anisotropic media. *Applied Thermal Engineering*, **93**, 529-536, 2016.

79. Palacios-Morales, C.A., J.P. Aguayo-Vallejo, Trujillo-Roldán, Zenit, R., M.A., Ascanio, G., Córdova-Aguilar, M.S., The flow inside shaking flasks and its implication for mycelial cultures. *Chemical Engineering Science*, **152**, 163–171, 2016.

80. Diaz-Damacillo, L., Ruiz-Angulo, A. and Zenit, R. Drift by air bubbles crossing an interface of a stratified medium at moderate Reynolds number. *International Journal of Multifase Flows*, **85**, 258-266, 2016.

81. Barbosa, C., Legendre, D. and Zenit R., The interaction of a bubble and an inclined wall. *Physical Review Fluids*, **1**, 032201(R), 2016.

82. Mancilla, E., Yatomi,R., Ascanio, G. and Zenit, R., Hydrodynamic Characterization of Three Axial Impellers under Gassed and Ungassed Conditions. *Journal of Chemical Engineering of Japan*, **49**, 894-903, 2016.

83. Guzman, J.E.V., Hernandez-Badillo, C. and Zenit, R. Experimental Study of the Deflections of Curved Plates Exposed to Pulsating Cross-Flows. *Acta Mechanica*, **227**, 3621-3637, 2016.

84. Linares-Guerrero, E., Hunt, M.L. and Zenit, R. Effects of inertia and turbulence on rheological measurements of neutrally-buoyant suspensions. *Journal of Fluid Mechanics*, **811**, 525-543, 2017.

85. Gómez, S., Godínez, F.A., Lauga, E. and Zenit, R., Helical propulsion in shear-thinning fluids. *Journal of Fluid Mechanics*, **812**, R3, 2017.

86. Salcedo, E., Treviño, C. Palacios-Morales, C.A. Zenit, R, Martínez-Suástegui, L., Experimental study on laminar flow over two confined isothermal cylinders in tandem during mixed convection. *International Journal of Thermal Sciences*, **115**, 176-196, 2017.

87. Aguilar-Corona, A., Masbernat, O., Figueroa, B., Zenit, R., The effect of column tilt on flow homogeneity and particle agitation in a liquid fluidized bed. *International Journal of Multiphase Flow*, **92**, 50-60, 2017.

88. Beltrán, A., Chávez, O., Zaldivar, J, Godínez, F.A., Garcia, A., Zenit, R., A new model for the computation of the formation factor of core rocks. *Journal of Structural Geology*, 92, 189-198, 2017.

89. de la Calleja, E.M., Zenit, R., Topological invariants can be used to quantify complexity in abstract paintings. *Knowledge-Based Systems*, 126, 48-55, 2017.

90. Zenit, R. and Feng, J. J. Hydrodynamic interactions among bubbles, drops and particles in non-Newtonian liquids. *Annual Review of Fluid Mechanics*, 50, 505-534, 2018.

91. Gómez, A.S., Conejo, A. N. and Zenit, R., Effect of separation angle and nozzle radial position on mixing time in ladles with two nozzles. *Journal of Applied Fluid Mechanics*, 11, 11-20, 2018.

92. Serrano-Garcia, J. C., Mendez-Diaz, S. and Zenit, R., The average properties of bidisperse bubbly flows. *Physical Review Fluids*, 3, 034306, 2018.

93. Figueroa-Espinosa, B., Mena, B., Aguilar-Corona, A., and Zenit, R., The lifespan of clusters in confined bubbly liquids. *International Journal of Muliphase Flows*, 106, 138-146, 2018.

94. González-Bernal. R., Solorio-Diaz, G., Ramos-Banderas, A., Torres-Alonso, E., Hernández-Bocanegra, C.A. and Zenit, R. Effect of the fluid-dynamic structure on the mixing time of a ladle furnace. *Steel Research International*, 89, 1700281, 2018.

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122. Ravisankar, M., and Zenit, R. Make a pancake: learn about viscosity, in preparation, 2023.

123. Remillard, S. and Zenit, R., Experimental Quantification of Hemolysis Through ECMO, in preparation, 2023.

124. Federle, M. and Zenit, R., A model for the interaction of an oil droplet and a gas bubble rising in a quiescent liquid, in preparation, 2023.

125. Avila Garcia, D., Rodriguez-Rodriguez, J., Zenit, R., Champougny, L., The Fluid Mechanics of splat painting, in preparation, 2023.

7 Seminars and presentations

Invited Seminars: 85; Congress Presentations: 64 (contributed).

7.1 Recent Invited Seminars

1. Locomotion of microorganisms in complex fluids, Mechanical Science and Engineering department seminar, University of Illinois. February, 2022.

2. Dynamics of viscous filaments: learning fluid mechanics from Jackson Pollock, Johns Hopkins Center for Environmental and Applied Fluid Mechanics, April 2022.

3. Bubbles and drinks, Multiphase Flows - Advances and Future Directions, October 2021.

4. Locomoción de microorganismos en fluidos complejos. Tenth anniversary of the Marcos Moshinsky Foundation, UNAM, Mexico. May 2021.

5. Dynamics of viscous filaments: learning fluid mechanics from Jackson Pollock, Mechanical Engineering Seminar, University of California Santa Barbara, May 2021; Fluids seminar, Cornell University, May 2021.

6. Hydrodynamic interactions in non Newtonian flows, Mechanical Engineering Seminar, Stanford University, October 2018; Fluids Seminar, Brown University, March 2018; Brazilian Multiphase Flow Conference, Sao Paolo, April 2017.

7. Hydrodynamic instabilities and modern artistic painting, Imperial College, UK, December 2017.

8. Non Newtonian bubbly liquids, MCE Seminar, California Institute of Technology, July 2016.

9. Siqueiros and Pollock, two takes on the same subject: painting with hydrodynamic instabilities, Winter Fluid Mechanics Seminar Series, Stanford University, March 2016.

10. Siqueiros, Pollock and hydrodynamic instabilities, Getty Conservation Institute, July 2015.

11. Locomotion of microorganisms in complex fluids, Bioseminar, on line, 2020; Instituto de Física, UNAM, September 2015.

7.2 Recent Presentations in Congresses

1. Learn about viscosity: make a pancake. 73 Annual Meeting of the Division of Fluids Dynamics, American Physical Society, Chicago, USA, November 2020.

2. Bubbles and drinks, R. Zenit, Invited Lecture, March Meeting, American Physical Society, Seattle, USA, March 2020.

3. Hydrodynamic interaction between two bubbles in-line in a viscoelastic liquid, R. Zenit, Invited Lecture, 72st Annual Meeting of the Division of Fluids Dynamics, American Physical Society, Seattle, USA, November 2019.

4. Mixing in bubbly columns in stratified liquids, R. Zenit, International Congress on Multiphase Flows, Rio de Janeiro, Brazil, May 2019.

5. The fluid mechanics of modern artistic painting, R. Zenit, Plenary Lecture, 71st Annual Meeting of the Division of Fluids Dynamics, American Physical Society, Atlanta GA, USA, November 2018.

6. Hydrodynamic instabilities and modern artistic painting, R. Zenit, Form in art, toys and games, Growth form and self-organisation, Isaac Newton Institute for Mathematical Sciences, November 2017.

7. Viscoelastic levitation, A. Castillo, R. Zenit, 70th Annual Meeting of the Division of Fluid Dynamics of the American Physical Society, Denver, U.S.A., November 2017.

8. Shear resuspension and rheology of dense particles at moderate and large Re, E. Linares-Guerrero, M. Hunt, R. Zenit, 69th Annual Meeting of the Division of Fluid Dynamics of the American Physical Society, Portland, U.S.A., November 2016.

9. Non Newtonian Bubbly Liquids, R. Zenit, Plenary Lecture, 9th International Conference on Multiphase Flow, Florence, Italy, May 2016.

10. The dynamics of a vortex ring crossing a density interface, R. Zenit, J.O. Dabiri, 68th Annual Meeting of the Division of Fluid Dynamics of the American Physical Society, Boston, U.S.A., November 2015.

8 Financed Research Projects

(Underlined projects reflect industrial funding)

1. Two-Phase Flows in Microgravity: bubble-based water remediation techniques, NASA EPSCOR GR5227106, 2021, $24,300.

2. The physics of artistic painting. Secretary of Culture, INBA, current until 2019, approximately $300,000.00 Mexican Pesos (does not include salaries).

3. Physical properties of core rocks. PEMEX-SENER-CONACYT, current until 2019, approximately $6,000,000.00 Mexican Pesos including equipment and salaries).

4. Reología y Arte. PAPIIT-UNAM , current until 2018, approximately $600,000.00 Mexican Pesos (seed funds, does not include salaries).

5. Permeability and electrical conductivity of core rocks for the Mexican Oil industry, TEMPLE (oil consulting company), approximately, $5,000,000.00 Mexican Pesos (including equipment and salaries).

6. Theoretical and experimental models for the locomotion of microorganisms in complex fluids, UCMEXUS- CONACyT , from 2011 to 2014, approximately $25,000.00 USD (seed funds, does not include salaries).

7. High speed tomographic PIV system, CONACyT, Infraestructura, 2012. approximately $1,200,000.00 Mexican Pesos (equipment grant).

8. Flow through heart valves, CONACyT, from 2009 to 2014. approximately $2,000,000.00 Mexican Pesos (does not include salaries).

9. Ultrasound velocimetry, PAPIIT (EXTRAORDINARIOS)-UNAM, 2009, approximately $200,000.00 Mexican Pesos (equipment grant).

10. Mixing efficiency of the Maxblend impeller, Sumitomo Heavy Industries, Japan, from 2009 to 2011, approximately $600,000.00 Mexican Pesos (section of larger grant, does not include salaries).

11. Emulsification of heavy petroleum residues (Emulsificación de residuos pesados de petróleo). UCMEXUS- CONACyT, from 2004 to 2005, approximately $25,000.00 USD (seed funds, does not include salaries).

12. Granular flow around objects, PAPIIT-UNAM and Microgravity Research Program NASA, from 2000 to 2003, approximately $200,000.00 USD (does not include salaries).

13. Collision of particles in Newtonian and non Newtonian liquids, Colisiones de partículas sumergidas en fluidos, PAPIIT-UNAM, from 2000 to 2003, approximately $600,000.00 Mexican Pesos (seed funds, does not include salaries).

14. Mechanics of bi-disperse bubbly flows. CONACyT, from 2000 to 2004, approximately $1,200,000.00 Mexican Pesos (start up grant, does not include salaries).

9 Consulting and Patents

9.1 Consulting

- Water treatment through polymer flocculation, Xicron, Inc., since 2009.
- Hydrodynamic performance of surgical catheters, Aptic, Inc. 2011.
- Rheology of cooling fluids, Sandvik, Inc. 2011.
- Performance of heart valve prosthesis, RYPSA, Inc. 2013.

9.2 Patents

- A rotating sedimenting sphere rheometer. 2014
- A helical robot to move through granular media. 2016.
- A biomimetic mixing impeller for viscous liquids, in preparation 2018.

10 Membership and activities in professional associations

1. Member of:
   (a) Sociedad Mexicana de Física (current)
   (b) Sociedad Mexicana de Ingeniería Mecánica (current)
   (c) American Physical Society (current)
   (d) American Society of Mechanical Engineers (ASME)
   (e) American Society of Chemical Engineers (AIChE)
2. President of División de Dinámica de Fluidos, Sociedad Mexicana de Física (2002-2004).
3. Co-Chair, IUTAM Symposium 'Hydrodynamic interactions in Newtonian and non Newtonian flows', Guanajuato, Mexico. March 2006.
4. Chair of the 'US-Mexico Minisimposium on Geophysical Flows'. Annual meeting of the Division of Fluid Dynamics, American Physical Society. Tampa Florida, USA, 2006.
5. Organizing committee member of 'Pan-American Advanced Studies Institute (PASI) on Interfacial Fluid Dynamics: From Theory to Applications'. Mar del Plata, Argentina, 2007.
6. Organizing committee member of the VIII, IX, X, XI, Congress of the División de Fluidos y Plasmas, Sociedad Mexicana de Física.
   - León Guanajuato, 2002.
   - México, D.F., 2003.
   - Hermosillo Sonora, 2004.
   - Guadalajara Jalisco, 2005.
7. Chair, IUTAM Symposium 'Dynamics of bubbly flows', Oaxaca, Mexico. March 2015.

11 Service

1. Referee for Journals: Physical Review Letters, Physical Review E, European Journal of Physics-E, Journal of Fluids Mechanics, Journal of Non-Newtonian Fluids Mechanics, Physics of Fluids, Experiments in Fluids, International Journal of Heat and Mass Transfer, Experimental Thermal and Fluid Science, International Journal of Multiphase Flow, American Institute of Chemical Engineering Journal, Chemical Engineering Science, Applied Rheology, Mechanics Research Communications, Acta Mechanica, European Journal of Physics E, Revista de la Sociedad Mexicana de Ingeniería Mecánica, Revista Mexicana de Física, Revista de la Sociedad Mexicana de Ingeniería Química, Journal of Hydraulic Research, Journal Of Applied Research and Technology, International Journal of Modeling, Simulation, and Scientific Computing, Applied Physics Letters, Asia-Pacific Journal of Chemical Engineering, Canadian Journal of Chemical Engineering, Granular Matter. Approximately 20 referrals per year.

2. Referee for funding agencies: CONACyT and PROMEP-SEP (Mexico); Agence Nationale de la Recherche (France); NASA Exploration Systems Mission Directorate (USA); Technologiestichting STW (The Netherlands).

3. Former member of the Editorial Board of: Physics of Fluids, from 2014 to 2015; International Journal of Multiphase Flow, from 2011 to 2017; Physical Review Fluids, from 2016 to 2020.

4. Current Member of the Editorial Board of: Acta Mechanica (since 2011) and Acta Mechanica Sinica (since 2020).

5. Member of the Graduate Council of Posgrado de Ciencia e Ingeniería de Materiales. Twice, from 2004 to 2006 and from 2010 to 2012.

6. Department Head. Departamento de Reología y Mecánica de Materiales, IIM-UNAM. Twice, from 2007 to 2009 and from 2011 to 2013.

7. Member of the advisory committee of the División de Ingeniería Eléctrica, Facultad de Ingeniería, UNAM. From 2008 to 2010.

8. Member of the advisory committee of the Centro de Ciencias Aplicadas y Desarrollo Tecnológico (CECADET), UNAM. From 2009 to 2014.

9. Elected member to the University Council. Member of the Academic Work Commission. From 2016 to 2020.

10. Member of the advisory Board of de Division of Mechanical and Industrial Engineering of the School of Engineering at UNAM. Since 2016.

11. Elected member of the Governing Board of the International Conference on Multiphase Flows. Since 2016.

12. Member of the External Affairs Committee of the Division of Fluid Dynamics of the American Physical Society. From 2016 to 2018.

13. Member at-large, Executive Committee , Division of Fluid Dynamics of the American Physical Society. Since 2020.

14. Associate Editor, International Journal of Multiphase Flows. From 2018 to 2021.

15. Associate Editor, Physical Review Fluids. Since January 2021.

16. Member of the Editorial Board of Annual Review of Fluid Mechanics. Since 2021.

17. Member of the Experimental Physics Investigators (EPI) Advisory Committee, Gordon and Betty Moore Foundation, since December 2021.

12 Awards and Distinctions

1. *Licenciatura* scholarship. DGAPA, Universidad Nacional Autónoma de México. 1992.
   Doctoral scholarship. Consejo Nacional de Ciencia y Tecnología of México. From 1992 to 1997.

2. Honors in thesis defense. Licenciatura en Ingeniería Mecánica y Eléctrica. 1992.

3. Richard Bruce Chapman Memorial Award, Assigned for distinguished research in hydrodynamics. California Institute of Technology. 1998.

4. Member of the *Sistema Nacional de Investigadores*, Level 3 (the highest)

5. Member of the *Academia Mexicana de Ciencias*, since 2003.

6. Invited Professor: Institute de Mecanique des Fluides de Toulouse (France) in 2003, 2004 , 2006 and 2009.

7. Chaire Mexique, Distinction, Université Paul Sabatier and Université Toulouse-le Mirail, January 2007.

8. Marcos Moshinsky Chair, Fundación Marcos Moshinsky, march 2012.

9. Milton Van Dyke Award, Gallery of Fluid Motion, DFD-APS Annual meeting, Pittsburgh, USA, November 2013.

10. Chaire TOTAL, Invited Professor, ESPCI, Paris, France, July 2014.

11. Fulbright Scholar, California Institute of Technology, August 2014 to July 2015.

12. Elected Member of the Academy of Engineering of Mexico. Since 2016.

13. Fellow, American Physical Society. Since 2016.

14. Simons Fellow, Isaac Newton Institute for Mathematical Sciences, November 2017.

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