

**Amrutur V. ANILKUMAR**

Professor of the Practice of Aerospace Engineering  
Professor of the Practice of Mechanical Engineering  
Vanderbilt University, Nashville, TN-37235

**Education:**

1983-1988: **Ph.D., Mechanical Engineering & Aeronautics**  
Graduate Aerospace Laboratories,  
California Institute of Technology, Pasadena, CA – 91125

1982-1983: **M.S., Mechanical Engineering**  
California Institute of Technology, Pasadena, CA – 91125

1977-1982: **B.Tech. Mechanical Engineering**  
Indian Institute of Technology, Madras, India – 600-036

**Leadership:**

2015-present Professor of the Practice of Aerospace Engineering  
2007-present: Professor of the Practice of Mechanical Engineering  
2014-present: Advisory Guest Professor, Indian Institute of Technology, Gandhinagar, India  
2013-present: Organizer, Roddam Narasimha Distinguished Seminar Series, IIT Gn, India  
2007-present: Director, Vanderbilt Aerospace Design Laboratory  
1989-2006: NASA Investigator of microgravity fluids phenomenon on Space Shuttle Missions (USML- I; 1992 and USML- II; 1995) and of materials processing phenomenon on the International Space Station (ISSI, PFMI; 2002-2003).  
2011-present: Director, Vanderbilt-Metro Water Renewable Energy Showcase Facilities  
2017-present Director, Vanderbilt University Trans-Institutional Satellite Initiative

**Honors & Awards:**

- **Abe Zarem Educator Award:** American Institute of Aeronautics & Astronautics, AIAA (2017)
- **Faculty Advisor of the Year:** American Institute of Aeronautics & Astronautics, AIAA (2016)
- **NASA Educational Engagement Awards:** for best inspiring the study of rocketry and STEM-related topics among younger students and their community (2014, 2012, and 2017).
- **Associate Fellow:** American Institute of Aeronautics and Astronautics, AIAA (2012).
- **Faculty Advisor for Orbital-ATK NASA Student Launch National Championship Teams** for the years 2013, 2014, 2015, 2016, and **National Space Club** second place team of 2017.
- **AIAA Special Awards:** for designing and executing a comprehensive STEM educational outreach program involving Aerospace Engineering, for sustained and outstanding achievement in Aerospace Engineering, for outstanding mentoring to Aerospace Club (AIAA TN Section; 2014, 2012, 2010).
- **Paladin Capital Marketplace Innovation Award** (@ EPA's American Innovation for Sustainability Forum in Washington, DC), for the design of the bio-hybrid solar cells, **2012 EPA P3 Award** (People, Prosperity and the Planet): for the quality of the design and bio-hybrid solar cell.
- **AIAA Faculty Booster Award** for steadfast commitment and outstanding leadership as the faculty advisor of the Vanderbilt University AIAA Chapter (AIAA TN Section, 2008).
- **Vanderbilt University School of Engineering Award for Excellence in Teaching** (2007).
- **NASA Public Service Group Achievement Awards** for outstanding support to the Space Shuttle mission operations (1996), and for outstanding support to the PFMI investigation aboard the International Space Station (2002).

- **NASA certificates** in recognition of outstanding contribution to success of USML-1(STS –50; 1992) & USML-2 (STS-73; 1995) Space Shuttle Missions and the PFMI investigations aboard the International Space Station (ISS; 2004).
- **Member Alpha Sigma Mu:** International Professional Honor Society for Materials Science and Engineering.

**Research Interests:**

- Aero-Thermodynamics: Rocket Propulsion and Flight Dynamics
- Energy Conversion: Wind, Thermoelectrics, Biodiesel
- Materials Processing: Float-Zones, Directional Solidification, Drop & Bubble Dynamics, Encapsulation

**Patents:**

- A Novel Reactor for Making Uniform Capsules', US Patent 6,001,312 (12/1999), with I. Lacik and T.G. Wang.
- An Encapsulation System for the Immunoisolation of Living Cells', US Patent 5,997,900 (12/1999), with T.G. Wang, I. Lacik, M. Brissova, and A.C. Powers.

**Teaching:**

- Aerospace Propulsion, Airplane Aerodynamics, Energetics Laboratory, Fluid Mechanics

**Journal Publications:**

1. A.V. Anilkumar, C.P. Lee, and T.G. Wang, 'Surface-tension-induced mixing following coalescence of initially stationary drops', *Physics of Fluids A* 3(11), 1991, pp. 2587-2591.
2. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'Static shape and instability of an acoustically levitated liquid drop', *Physics of Fluids A* 3(11), 1991, pp. 2497-2515.
3. A.V. Anilkumar, R.N. Grugel, X.F. Shen, C.P. Lee, and T.G. Wang, 'Control of thermocapillary convection in a liquid bridge by vibration', *Journal of Applied Physics* 73(9), 1993, pp. 4165-4170.
4. A.V. Anilkumar, R.S.J. Sparks, and B. Sturtevant, 'Geological implications and applications of high-velocity two-phase flow experiments', *Journal of Volcanology and Geothermal Research* 56, 1993, pp. 145-160.
5. A.V. Anilkumar, C.P. Lee, and T.G. Wang, 'Stability of an acoustically levitated and flattened drop: an experimental study', *Physics of Fluids A* 5(11), 1993, pp. 2763-2774.
6. T.G. Wang, A.V. Anilkumar, C.P. Lee, and K.C. Lin, 'Core centering of compound drops in capillary oscillations: observations on USML-1 experiments in Space', *Journal of Colloid and Interface Science* 165, 1994, pp. 19-30.
7. T.G. Wang, A.V. Anilkumar, C.P. Lee, and K.C. Lin, 'Bifurcation of rotating liquid drops: results from USML-1 experiments in Space', *Journal of Fluid Mechanics* 276, 1994, pp. 389-403.
8. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'Static shape of an acoustically levitated drop with wave-drop interaction', *Physics of Fluids* 6(11), 1994, pp. 3554-3566.
9. R.N. Grugel, X.F. Shen, A.V. Anilkumar, and T.G. Wang, 'The influence of vibration on microstructural uniformity during floating-zone crystal growth', *Journal of Crystal Growth* 142, 1994, pp. 209-214.
10. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'Interactions of liquid drops with a levitating sound field', in *Current Topics in The Physics of Fluids*, edited by Council of Scientific Information (Research Trends, Trivandrum, India, 1995).
11. T.G. Wang, A.V. Anilkumar, and C.P. Lee, 'Oscillations of liquid drops: results of USML-1 experiments in Space', *Journal of Fluid Mechanics* 308, 1996, pp. 1-14.

12. X.F. Shen, A.V. Anilkumar, R.N. Grugel, and T.G. Wang, 'Utilizing vibration to promote microstructural homogeneity during floating-zone crystal growth processing', *Journal of Crystal Growth* 165, 1996, pp. 438-446.
13. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'Streaming generated in a liquid bridge due to nonlinear oscillations driven by vibration of an end wall', *Physics of Fluids* 8(12), 1996, pp. 3234-3246.
14. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'A theoretical model for centering of a thin viscous liquid shell in free and forced capillary oscillations', *Physics of Fluids* 8(10), 1996, pp. 2580-2589.
15. T. Wang, I. Lacik, M. Brissova, A.V. Anilkumar, A. Prokop, D. Hunkeler, R. Green, K. Shahrokhi and A.C. Powers, 'A new generation capsule and encapsulation system for immunoisolation of pancreatic islets', *Nature: Biotechnology* 15, 1997, pp. 358-362.
16. A.C. Powers, M. Brissova, I. Lacik, A.V. Anilkumar, and T.G. Wang, 'Permeability assessment of capsules for islet transplantation', *Annals of the New York Academy of Sciences* 831, 1997, pp. 208-216.
17. M. Brissova, I. Lacik, A.C. Powers, A.V. Anilkumar, and T.G. Wang, 'Control and measurement of permeability for design of microcapsule cell delivery system', *Journal of Biomedical Materials Research* 39(1), 1998, pp. 52-60.
18. I. Lacik, A.V. Anilkumar, M. Brissova, A.C. Powers, and T.G. Wang, 'New capsule with tailored properties for the encapsulation of living cells', *Journal of Biomedical Materials Research* 39(1), 1998, pp. 61-70.
19. C.P. Lee, A.V. Anilkumar, A.B. Hmelo and T.G. Wang, 'Equilibrium of liquid drops under the effects of rotation and acoustic flattening: results from USML-2 experiments in Space', *Journal of Fluid Mechanics* 354, 1998, pp. 43-67.
20. Grugel, R.N., Lee, C.P., Anilkumar, A.V. et al. 'Utilizing microgravity environment to investigate thermocapillary flow and microstructural uniformity during floating-zone crystal growth', *Journal of The Japan Society of Microgravity Applications*, 15 (supp. II), 1998, pp. 407-412.
21. A.V. Anilkumar, J. Bhowmick, and R.N. Grugel, 'Effect of end-wall vibration on oscillatory thermocapillary flow in float-zones', Reviewed Proceedings of the twelfth International Symposium on Experimental Methods in Microgravity Materials Science, TMS Meeting, March 2000, Nashville, TN; R. Schiffman, editor.
22. A.V. Anilkumar, T.G. Wang, and I. Lacik, 'A novel reactor for making uniform capsules', *Biotechnology and Bioengineering*, 75 (5), 2001, pp. 581-589.
23. A.V. Anilkumar, A.B. Hmelo, and T.G. Wang, 'Core centering of immiscible compound drops in capillary oscillations: experimental observations', *Journal of Colloid and Interface Science* 242, 2001, pp. 465-469.
24. Brissova, M., Anilkumar, A.V., Powers, A.C., and Wang, T.G., 'Biocompatibility of microcapsule immunoisolation device for pancreatic islet transplantation', *Journal of Biomedical Research*, 2001.
25. Lacik, I., Anilkumar, A.V., and Wang, T.G., 'A two-step process for controlling the surface smoothness of polyelectrolyte-based microcapsules', *Journal of Microencapsulation*, 18 (4), 2001, pp. 479-490.
26. R.N. Grugel, A.V. Anilkumar, and C.P. Lee, 'Direct observation of pore formation and mobility during controlled melting and re-solidification in microgravity', in *Solidification Processes and Microstructures: A Symposium in Honor of Prof. W. Kurz*, M. Rappaz, C. Beckermann, and R. Trivedi, editors, TMS Publication 2004.
27. A.V. Anilkumar, R.N. Grugel, J. Bhowmick, and T.G. Wang, 'Suppression of thermocapillary oscillations in sodium nitrate half-zones by high-frequency end-wall vibrations', *Journal of Crystal Growth*, 276, 2005, pp. 194-203.
28. Q. Deng, A.V. Anilkumar, and T.G. Wang, 'Role of viscosity and surface tension in bubble entrapment during liquid drop impact onto surface of a deep liquid pool', *J. Fluid Mech.* (2007), vol. 578, pp. 119-138.

29. R.N. Grugel, P. Luz, G. Smith, R. Spivey, L. Jeter, D. Gillies, F. Hua, A.V. Anilkumar, 'Materials research conducted aboard the International Space Station: facilities overview, operational procedures, and experimental outcomes', *Acta Astronautica* 62 (2008), pp. 491-498.
30. M.C. Cox, A.V. Anilkumar, R.N. Grugel and C.P. Lee, 'Effect of step-wise change in processing pressure on isolated pore growth during controlled directional solidification in small channels', *Journal of Crystal Growth* 311 (2009), pp. 327-336.
31. Q. Deng, A.V. Anilkumar, and T.G. Wang, 'The phenomenon of bubble entrapment during capsule formation', *Journal of Colloid and Interface Science* 333 (2009), 523-532.
32. Chun P. Lee, Amrutur V. Anilkumar, and Richard N. Grugel, 'Dynamics of gas evacuation from a honey comb structure having common wall perforations', *Journal of Spacecrafts and Rockets* 47 (2010), 649-658.
33. Richard N. Grugel, Lucien N. Brush, and Amrutur V. Anilkumar, 'Disruption of an aligned dendritic network by bubbles during re-melting in a microgravity environment', *Microgravity Science and Technology* 24 (2012), 93-101.
34. C.P. Lee, A.V. Anilkumar, M.C. Cox, C.B. Lioi, and R.N. Grugel, 'Evolution of elongated pores at the melt-solid interface during controlled directional solidification', *Acta Materialia* 61 (2013), 3752-3757.
35. A. S. Westover, J. W. Tian, S. Bernath, L. Oakes, R. Edwards, F. N. Shabab, S. Chatterjee, A. V. Anilkumar, and C. L. Pint, 'A Multifunctional Load-Bearing Solid-State Supercapacitor', *Nano Lett.*, 2014, 14 (6), 3197–3202.
36. P.S. Kumar, W. Emfinger, G. Karsai, D. Watkins, B. Gasser, and A. Anilkumar, 'ROSMOD: A Toolsuite for Modeling, Generating, Deploying, and Managing Distributed Real-time Component-based Software using ROS', *Electronics*, 2016, 5(3), 53-98.

**Conference Publications:**

37. A.V. Anilkumar, and T.G. Wang, 'Drop coalescence studies', Proceedings of NASA Workshop on Containerless Experimentation in Microgravity, Pasadena, CA (1990).
38. B. Sturtevant, H. Glicken, L. Hill, and A.V. Anilkumar, 'Explosive volcanism in Japan and United States: gaining understanding by shock tube experiments', Proceedings of the Eighteenth International Symposium on Shock Waves, Japan (1991).
39. X.F. Shen, R.N. Grugel, A.V. Anilkumar, and T.G. Wang, 'The influence of controlled surface streaming on thermocapillary convection during float-zone solidification processing', Proceedings of the Symposium on Microstructural Design by Solidification Processing, TMS Fall Meeting, Chicago, IL (1992).
40. C.P. Lee, A.V. Anilkumar, and T.G. Wang, 'The behavior of a liquid drop levitated and drastically flattened by an intense sound field', AIAA 92-0112, Proceedings of the thirtieth Aerospace Sciences and Exhibit, Reno, NV (1992).
41. A.V. Anilkumar, C.P. Lee, and T.G. Wang, 'Momentumless coalescence of drops', AIAA 92-0111, Proceedings of the thirtieth Aerospace Sciences Meeting and Exhibit, Reno, NV (1992).
42. R.N. Grugel, X.F. Shen, A.V. Anilkumar, and T.G. Wang, 'The influence of controlled shape oscillation on microstructural uniformity and development during floating-zone crystal growth', Proceedings of the International Workshop on G-jitter, Clarkson University, Potsdam, NY (1993).
43. T.G. Wang, A.V. Anilkumar, C.P. Lee, and K.C. Lin, 'A preliminary analysis of the USML-1 drop dynamics experimental results', AIAA 93-0252, Proceedings of the thirty-first Aerospace Sciences Meeting and Exhibit, Reno, NV (1993).
44. T.G. Wang, A.V. Anilkumar, C.P. Lee, and K.C. Lin, 'Bifurcation of rotating liquid drops', NASA Conference Publication 3272, Proceedings of Joint Launch + One Year Science Review of USML-1, Huntsville, AL (1993).

45. T.G. Wang, A.V. Anilkumar, C.P. Lee, and K.C. Lin, 'Core-centering of compound drops in capillary oscillations', NASA Conference Publication 3272, Proceedings of Joint Launch + One Year Science Review of USML-1, Huntsville, AL (1993).
46. A. V. Anilkumar, C.P. Lee, and T.G. Wang, 'Studies of the stability and dynamics of levitated drops', Proceedings of the Third Microgravity Fluid Physics Conference, Cleveland, Ohio (1996).
47. A.V. Anilkumar, and R.N. Grugel, 'Role of vibration-induced streaming in float-zone crystal growth', Proceedings of the ASME 2000 International Mechanical Engineering Conference and Exposition, Orlando, FL (2000).
48. C.P. Lee, A.V. Anilkumar, and R.N. Grugel, 'Role of vibration-induced streaming in float-zone crystal growth', AIAA 01-0614, Proceedings of the thirty-ninth Aerospace Sciences Meeting and Exhibit, Reno, NV (2001).
49. R.N. Grugel, A.V. Anilkumar, A.I. Fedoseyev, and K. Mazuruk, 'Some Novel Solidification Processing Techniques being Investigated at MSFC – Their Extension for Study Aboard the ISS', AIAA 01- 5054, AIAA Conference on International Space Station Utilization, Kennedy Space Center, Orlando, FL (2001).
50. R.N. Grugel, A.V. Anilkumar, P. Luz, L. Jeter, M.P. Volz, R. Spievy, and G. Smith, 'Toward Understanding Pore Formation And Mobility During Controlled Directional Solidification in a Microgravity Environment Investigation (PFMI), AIAA 01-5119, AIAA Conference on International Space Station Utilization, Kennedy Space Center, Orlando, FL (2001).
51. R.N. Grugel, A.V. Anilkumar, and C.P. Lee, 'Pore Formation and Mobility Investigation (PFMI): Description and Initial Analysis of Experiments Conducted aboard the International Space Station', Proceedings of the *Spacebound 2003* Conference, Toronto, Canada (2003).
52. R.N. Grugel, and A.V. Anilkumar, 'Bubble formation and transport during directional solidification in microgravity: model experiments on the Space Station', AIAA 04-627, Proceedings of the 42nd AIAA Aerospace Sciences Meeting and Exhibit, Reno, Nevada, Jan. 5-8, 2004
53. R.N. Grugel, A.V. Anilkumar, and M.C. Cox 'Observations of an aligned gas-eutectic during controlled directional solidification aboard the International Space Station-comparison with ground-based studies', AIAA 05-919 Proceedings of the 43rd AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV. Jan 10 - 13, 2005
54. M.C. Cox, A.V. Anilkumar, R.N. Grugel, and W.H. Hofmeister, 'Isolated Wormhole Growth and Evolution during Directional Solidification in Small Diameter Cylindrical Channels: Preliminary Experiments', AIAA 06-1140, Proceedings of the 44th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV. Jan 9 - 12, 2006
55. R. Grugel, F. Hua, A.V. Anilkumar, et al., 'The In-Space soldering investigation (ISSI): melting and solidification experiments aboard the International Space Station', AIAA 06-521, Proceedings of the 44<sup>th</sup> AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, Jan 9-12, 2006.
56. R.N. Grugel, A.V. Anilkumar et al. 'Materials Research conducted aboard the International Space Station: Facilities, Overview, Operational Procedures, and Experimental outcomes', IAC 06-A2.5.1 Proceedings of the 57<sup>th</sup> International Astronautical Congress (IAC), Valencia, Spain, October 2-6, 2006.
57. B. T. Blandford, W.O. Runge, Shengteng Hu, A.V. Anilkumar, R.W. Pitz and J.A. Wehrmeyer, 'Hydroxyl Tagging Velocimetry (HTV) to Measure Centerline Velocities in the Near Field Exhaust of a Gas Turbine Engine, AIAA-2008-0235, Proceedings of the 46<sup>th</sup> AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, Jan 7-10, 2008.
58. A. Alexander, J. Wehrmeyer, W. Runge, B. Blandford, A.V. Anilkumar, and R.W. Pitz, 'Nonintrusive Measurement of Gas Turbine Exhaust Velocity using Hydroxyl Tagging Velocimetry', AIAA-2008-3709, Proceedings of the 26<sup>th</sup> AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Seattle, Washington June 23-26, 2008.
59. Richard N. Grugel, Lucien N. Brush, and Amrutur V. Anilkumar "Disruption of an Aligned Dendritic Network by Bubbles during re-melting in a Microgravity Environment" 50th AIAA

- Aerospace Sciences Meeting, 9 - 12 Jan 2012, Nashville, TN in *26th Symposium on Gravity - Related Phenomena in Space Exploration*.
60. Andrew S. Westover, John Tian, Shiva Bernath, Landon Oakes, Rob Edwards, Farhan Nur Shabab, Shahana Chatterjee, Amrutur Anilkumar, and Cary L. Pint, "Multifunctional Load-Bearing Energy Storage Materials", IMECE2014-38931: Proceedings of the 2014 International Mechanical Engineering Congress and Exposition, November 14-20, 2014, Montreal, Canada.
  61. Pranav Srinivas Kumar, William Emfinger, Amogh Kulkarni, Gabor Karsai, Dexter Watkins, Benjamin Gasser, Cameron Ridgewell and Amrutur Anilkumar, "ROSMOD: A Toolsuite for Modeling, Generating, Deploying, and Managing Distributed Real-time Component-based Software using ROS", IEEE International Symposium on Rapid System Prototyping, October 8-9, 2015, Amsterdam, The Netherlands.

#### **Recent Invited Lectures & Panels (2016-17):**

1. Extreme Engineering: A New Paradigm For Top-Class Engineering Education; 5th June, 2017, IIT Gandhinagar, Gujarat, India <https://www.youtube.com/watch?v=2UZRnHPM5yw>
2. Aerospace Systems Engineering: The Way Forward; Aug 11, 2016, IC & SR Auditorium, IIT Madras, Chennai, India <https://www.youtube.com/watch?v=rB1g9AoV8vk>
3. IIT Gandhinagar Lecture Series 'Aerospace Systems Engineering: The Way Forward?' Aug 9, 2016.
4. 'Trends in Engineering: AIAA Education Panel', Amrutur Anilkumar (Vanderbilt University), Wayne Johnson (Tennessee Tech), Matthew Mensch (UT, Knoxville), Trevor Moeller (UTSI), and Michael Glennon (AEDC), March 30, 2017, UTSI, TN  
<https://aerospaceamerica.aiaa.org/bulletin/julyaugust-2017-aiaa-bulletin/>
5. Space Exploration Lecture: 'Houston, Vandy has a solution!', Vanderbilt Alumni Association, Houston Chapter, Office of Jones Day, Conference Room, 717 Texas Ave, Houston, TX 77002  
<http://www.vuconnect.com/s/1643/index.aspx?sid=1643&gid=2&pgid=3952&cid=6952&ecid=6952&ciid=15291&crd=0>

#### **Current Projects:**

1. Vanderbilt University Satellite Initiative (2017-2019), \$ 156,000.
2. Vanderbilt MWS Renewable Energy Showcase (ongoing), \$97,000

#### **Recent News Articles (2015-17)**

1. **AIAA Faculty Advisor of the Year:** (a) <https://engineering.vanderbilt.edu/news/2016/institute-of-aeronautics-names-anilkumar-2016-faculty-advisor-of-the-year/> (b) <https://www.aiaa.org/SciTech2016AwardsPresented/>
2. **Abe Zarem Award:** (a) <https://engineering.vanderbilt.edu/news/2016/mechanical-engineering-graduate-student-collects-national-and-international-astronautical-awards/> (b) <https://www.aiaa.org/SecondaryTwoColumn.aspx?id=35039>
3. **Renewable Energy:** <https://engineering.vanderbilt.edu/news/2017/love-circle-energy-park-to-reach-5-years-of-continuous-operation/>
4. **NASA University Student Launch:** (a) <https://news.vanderbilt.edu/2016/05/12/vanderbilt-student-rocketeers-win-fourth-national-championship-in-a-row/> (b) <https://engineering.vanderbilt.edu/solutions/rocketeers.php> (c) <https://engineering.vanderbilt.edu/news/2017/student-rocketeers-earn-second-place-in-nasa-contest/>
5. **NASA Mars Challenge:** (a) <http://spaceref.com/news/viewsr.html?pid=47184> (b) <https://engineering.vanderbilt.edu/news/2015/vanderbilt-aerospace-club-continues-its-winning-ways-at-national-rocket-competition/>