Pedro E. Arce, PhD

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Education

1. **"Título de Ingeniero Químico"** (Chemical Engineering Diploma). Facultad de Ingeniería Química (FIQ), Universidad Nacional del Litoral (UNL), Santa Fe, Argentina, 1977**.** Minor in *Heterogeneous Catalysis*. Undergraduate Mentor: Professor **Eduardo A. Lombardo**, Cátedra de Físico-Química and "Institute for Catalysis and Petrochemical Research", INCAPE, FIQ.
2. **Master of Sciences Degree** in Chemical Engineering, Purdue University, West Lafayette, IN-USA, 1987 • Thesis Title: *Transport in Solid-Fluid Interacting Systems. An Operator - Theoretic Approach* • Major Professor: **D. Ramkrishna**, **PhD**, Harry C. Pfeffer Distinguished Professor of Chemical Engineering and USA-National Academy of Engineering, Member.
3. **Doctor of Philosophy (Ph.D.)** in Chemical Engineering, Purdue University, West Lafayette, IN-USA,1990 • Thesis Title: *Fluid-Mediated Interactions among Particles in a Catalytic Reactor*. • Major Professor: **D. Ramkrishna**, **PhD**• Applied Mathematics Supervisor: **James K. Thurber**, **PhD**, Professor of Applied Mathematics at Purdue University, West Lafayette, IN-USA.

Training and Certifications

4. **Postgraduate Studies Program** in Chemical Engineering. Universidad Nacional del Litoral and Instituto de Desarrollo Tecnológico para la Industria Química, INTEC, Santa Fe, Argentina. Director: **Alberto E. Cassano, PhD**. The program featured research, course work, and mentoring efforts, 1978-1983 • Research Topic (first two years): a- *Kinetic Mechanisms for the Catalytic Hydrogenation of Vegetable Oils* and b-*Gas-solid Non-Catalytic Reactions Reactor Modeling.* Co-Director: Luis E. Arri, PhD • Research Topic (last three years): *Reacting Fluids under Laminar Flow Regime: A Computational Integral-Equation Approach.* Co-Director: Horacio A. Irazoqui, PhD• Course Work: Program included thirteen graduate level courses at the intermediate and advanced level in applied mathematics, fluid-mechanics, thermodynamics, transport phenomena, and kinetics.
5. **Certificate of English Studies**, Anglo-Continental School of English, Bournemouth, England, 1981, Accredited by the British Council of Education, United Kingdom.
6. **Academic Leadership Certificate**, Tennessee Board of Regents (TBR) Academic Leadership Institute (RALI) in collaboration with the Chair Academy. • Institute Director: Dr. Treva Berryman, Associate-Vice Chancellor, TBR; (the late) Dr. Gary Filan and Dr. Judy Korb (Chair Academy, co-leaders), 2007. Program established by TBR Vice-Chancellor, Dr. Paula Short, (current Provost, University of Houston, Houston, TX).
7. **Advanced Leadership Certificate**, Chair Academy in collaboration with the Tennessee Board of Regents (TBR). • (The late) Dr. Gary Filan, Director; Dr. I. Karre and Dr. E. Elford, Co-Leaders, 2010.
8. **USA Soccer Association,** Youth Soccer Coaching License (A. Warner, Master Coach,1995) and **Brazilian Soccer Master Coaching License** (T. Gonzalvez, Master Coach, 1997).

Professional Statement

Since Dr. Arce joined the TTU Department of Chemical Engineering in 2003, he has been focusing on bringing Biotechnology-centered opportunities to both undergraduate and graduate students. Key accomplishments include the development and implementation of the successful Biomolecular Engineering Concentration (currently enrolling more than one hundred students) and the hiring of several Chemical Engineering faculty with biotechnology-focused research interests. These include Dr. J. R. Sanders (Director of the Biomolecular Medicine Laboratory); Dr. J. Rice (Director of the Protein Engineering Laboratory); Dr. J. Pascal (Director of the Cancer Research Group), Dr. L. Zhang (Director of the Protein Molecular Simulation Group) and Dr. L. Arias-Chavez (Director of the Membrane-Based Laboratory). Close collaboration with the ORNL and the Cookeville Regional Center have led to two USA-Patents for Nanocomposite Hydrogel Materials for Clinical Diagnostics. In collaboration with the TTU Center for Health Care Informatics, the TTU Department of Biology and the TTU School of Nursing, Chemical Engineering is in the final stages of the development of a new concentration in Health Care Engineering.

Academic and Other Research Positions (selected)

1. Graduate Studies Program Fellow, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET, National Council of Research), 1978-1983. Instituto de Desarrollo Tecnológico para Ia Industria Química, INTEC, Universidad Nacional del Litoral, Santa Fe, Argentina.
2. Member of the Scientific and Technological Research Staff Career, (Carrera del Investigador Científico y Tecnológico de) CONICET, Argentina, 1982-1990.
3. International Graduate Fellow (CONICET) and Research Assistant, School of Chemical Engineering, Purdue University, West Lafayette, IN (January 1984-August 1990).
4. Instructor at the School of Chemical Engineering, Purdue University, West Lafayette, IN during Fall 1989 for CHE 434-Laboratory of Transport Processes.[1]
5. Assistant Professor (Tenure Track, 65% Research, 35% Teaching) of Chemical Engineering. Department of Chemical Engineering, College of Engineering (Florida A&M University and Florida State University), Tallahassee, FL (October 1990-August l995).
6. Faculty Associate of the Center for Materials Research and Technology MARTECH (Florida State University), (1991-2002).
7. Associate Professor (Tenured) of Chemical Engineering. Department of Chemical Engineering, College of Engineering (Florida A&M University and Florida State University), Tallahassee, Florida (August l995-2002).
8. Faculty Associate of the Geophysical Fluid Dynamics Institute, GFDI, Florida State University (Elected by the GFDI Faculty, 1997- 2002).
9. American Electrophoresis Society, AES. Elected to the Society Board (1999-2002; re-elected, second term: 2003-2005).
10. Professor and Chair, Department of Chemical Engineering, Tennessee Technological University (January 2003-).

Honors, Recognitions and Awards (Selected)

1. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET, National Council of Research), Argentina. Elected Member to the Scientific and Technological Research Staff Career, 1982. Recognition based on excellence in research during the Postgraduate Studies Program.
2. Banco Interamericano de Desarrollo (BID) and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) Program for Graduate Studies, l983-1986. International Fellowship, Purdue University, School of Chemical Engineering[2].

[1] Invitation extended based on the outstanding performance in the Doctoral Program.
[2] Most prestigious science and technology fellowship in Argentina.

3. Purdue University, Research Foundation and School of Graduate Studies, West Lafayette, IN, David Ross University Fellowship, l988-1990.
4. American Institute of Chemical Engineering (AIChE) Student Chapter, Department of Engineering, College of Engineering (Florida A&M and Florida State University), Tallahassee, FL. Professor of the Year Award, 1990-l99l.
5. Sigma Xi, Scientific Research Society, Florida State University Chapter, Tallahassee, FL. Elected Full Member, 1993. Transfer to Tennessee Tech University, 2003.
6. American Society for Engineering Education (ASEE). Thomas C. Evans Award for the most outstanding paper in engineering education 1994, 2001, 2008.
7. Fulbright-LASPAU (affiliated with Harvard University). Invited Lecturer for Latin America, Fall 1994.
8. Board of Regents, Florida University System. Teaching Incentive Program Award (TIP), for Excellence in Teaching, 1994-1995. Most prestigious award for Excellence in Teaching.
9. Selected as one of the five most outstanding Honors Professors by students of the "Honors Program in the Major", Florida State University, Tallahassee, Florida [Und. Stud. Herald, 2-3, Fall 1994].
10. University of Cambridge, UK, Herschel Smith Laboratory for Medicinal Chemistry, School of Clinical Medicine, Invited Scientist, Summer 1995.
11. Florida State University. Developing Scholar Award, for Excellence in Scholarly Activities, 1996-1997. Most prestigious award for an associate professor for Excellence in Research.
12. Universidad Católica del Norte, Antofagosta, Chile, Invited Plenary Lecturer, Tutorial: "External Field Technologies to Control Contaminants in Aqueous Effluents," October, 1998. Activity performed as part of the "II Encuentro Latino Americano de Ingeniería Química."
13. National Science Foundation, NSF-SUCCEED Award for Innovative Teaching. College of Engineering, Florida A&M University and Florida State University, 1999-2000.
14. National Science Foundation, NSF- Invited Member of the Site Visit Panel, ERC-NSF Program, three times.
15. National Science Foundation, NSF, Several Panel Reviewer Invitations: Directorate of Undergraduate Engineering Education, Transport and Chemical Processes, Biomedical, among others, 1999-Present.
16. Associación de Física Argentina, AFA, Opening Plenary and Semi-Plenary Lecturer (Invited), 84th Annual Meeting, Department of Physics, Universidad Nacional de Tucumán, San Miguel de Tucumán, Argentina. September 17-23, 1999.
17. University of South Florida, Tampa, FL. Department of Chemical Engineering. External Examiner for Dr. Maria Celis Arce (Director: Dr. Luis Garcia Rubio. Thesis "Studies of Initial Conditions in Emulsion Polymerization Reactors," Defense: August 3, 2000).
18. National Science Foundation, NSF-SUCCEED Award for Innovative Teaching. College of Engineering, Florida A&M University and Florida State University, 2000-01. This work is profiled in the ASEE Magazine "*Prism*," April (2001).
19. XIV Congreso Nacional de Ingeniería Química, Universidad de Santiago, Chile, October 2000. Invited Plenary Lecturer: "Electro-Assisted Technologies in the Decontamination and Clarification of Sewage Water and Other Processing Fluids."
20. Universidad Nacional Mayor de San Marcos, Lima, Perú. Department of Chemistry and Chemical Engineering. Invited Visiting Professor, November 2000. Graduate level course: "Advanced Topics in Transport Phenomena."
21. American Society for Engineering Education (ASEE): Thomas C. Evans Award, Instructional Paper Award for the most outstanding paper in engineering education, 1994, 2001, 2008, 2014.
22. Guest Editor for the Special Issue of *Electrophoresis* on Interdisciplinary Sciences, 2003.
23. Tennessee Tech University, College of Engineering. "Leighton Sissom Award" for Innovation and Creativity in Engineering Education, 2005, 2012.
24. American Society of Engineering Education. "2005-Mid-Career Outstanding Teaching Award" for Outstanding/Continued Contributions to the Engineering Curriculum and Instruction.
25. Tennessee Tech University, 2006 College of Engineering Dean Advisory Award for a Life-Time Commitment to the Improvement of Student Learning in Engineering and Leadership Skills as Chair of Chemical Engineering.
26. Tennessee Technological University, College of Engineering. "Brown-Henderson Award" for Outstanding Efforts in Research, Teaching and Service, and most prestigious award within the COE, 2008.
27. Purdue School of Chemical Engineering, "Chemical Engineering of the Future" Invited Panelist, September 24-25, 2009.
28. National Science Foundation-Engineering Research Centers, Annual Meeting, Invited Key Note Speaker, Washington, DC, 2009.

29. Tennessee Technological University, **2010 University Distinguished Faculty Fellow**, most prestigious award (post-tenure) for a faculty at TTU.
30. Chair Academy, 2014 I. Karre Award for Outstanding Transformational Leadership in "Campus Academic Programs"
31. Tennessee Technological University, 2014 Outstanding Faculty Award for Professional Services
32. Tennessee Technological University, 2015 Donald Caplenor Award for Excellence in Research.

Peer-Reviewed Publications

Dr. Arce is the author or co-author of more than 120 publications in peer-reviewed journals and reviewed proceedings. The list below is a selected list from these. Dr. Arce has been the Major Professor for more than 130 projects including Undergraduate Honors in the Major Research, Master and PhD Degrees as well as summer research and postdoctoral researchers. Some of his publications have received wide independent citation. Currently, Dr. Arce's group has in the order of 15 manuscripts in preparation for publication, under review, or in draft form.

1. Simhadri, J., H. Stretz and P.E. Arce, "Role of Chanel Morphology in Electrophoresis Separation: An Optimization by Differential Evolution," *Brazilian Journal of Chemical Engineering*, 2015 (accepted).
2. Simhadri, J., H. A. Stretz, M. A. Oyanader and P.E. Arce, "Assessing Performance of Irregular Microvoids in Electrophoresis Separation," *I&E Chemistry Research,*54(42), 10434-10441, (2015).
3. Arce, P. E., J. R. Sanders, A. Arce-Trigatti, L. Loggins, J. Biernacki, M. Geist, J. Pascal and K. Wiant, "The Renaissance Foundry", *Critical Conversation Interdisciplinary Journal*, Vol II, 176, 2015.
4. Oyanader, M., Pedro E. Arce, and James D. Bolden, "Role of Joule Heating in Electro-Assisted Processes: A Boundary Layer Approach for Rectangular Electrodes," *International Journal of Chemical Reactor Engineering*, Published on line on 08/06/2013. Invited contribution for Dr. A. E. Cassano[3] Honoring Issue.
5. Oyander, M. and P.E. Arce, "Role of Aspect Ratio and Joule Heating within the Fluid Region Near a Cylindrical Electrode in Electrokinetic Remediation: A Numerical Solution based on the Boundary Layer Model", *International Journal of Chemical Reactor Engineering*, Published on line on 08/25 /2013. Invited contribution for Dr. A. E. Cassano Honoring Issue.
6. Thompson, J., H. A. Stretz, P. E. Arce, H. Gao, H. J. Ploehn, and J. He, "Effect of Magnetization on the Gel Structure and Protein Electrophoresis in Polyacrylamide Hydrogel Nanocomposites," *Journal of Applied Polymer Sciences*, 126, 1600-1612, (2012).
7. Pascal, J. A., M. Oyanader, P. E. Arce, "Effect of Capillary Geometry on Predicting Electroosmotic Volumetric Flowrates in Porous or Fibrous Media," *Journal of Colloid and Interface Science*, 378 (1), 241-250, (2012).
8. Simhadri, J., H. Stretz, P. E. Arce, and M. Oyanader, "Morphology of Nanocomposite and Template Gels and its Role in the Separation of Biomolecules: A Review," *I&EC Research*, 49(23), 12104-12110, (2010).
9. Pascal, J.A., M.A. Oyanader, and P.E. Arce, "Effect of Wall Velocities on the Determination of Optimal Separation Times in Electrical Field Flow Fractionation," *The Canadian Journal of Chemical Engineering*, 88(3), 384-391,(2010).
10. Thompson, J., H. A. Stretz, and P. E. Arce , "Preliminary Observations of the Role of Material Morphology on Protein-Electrophoretic Transport in Gold Nanocomposite Hydrogels" *I&EC Research*, 49(23), 11866-11877, (2010).
11. Kasavajjula, U.S., C. Wang and P. E. Arce, "A Discharge Model for $LiFePO_4$ Accounting the Effect of Solid Solution Range and Particle Size," *Journal of the Electrochemical Society,* 1159 (11), A866-A874, (2008).

[3] Dr. Alberto E. Cassano was Dr. Arce first postgraduate research adviser and mentor.

12. P.E. Arce, M. Quintard, S. Whitaker, 2005, "The Art and Science of Upscaling," Chapter 1 in *Chemical Engineering: Trends and Developments*, edited by M.A. Galán and Eva Marin de Valle, John Wiley & Sons, Ltd., England, (2005).
13. M. Oyanader, P. Arce, A. Dzurik, "Design Criteria for Soil Cleaning Operations in Electrokinetic Remediation. Hydrodynamic Aspects in an Annular Geometry," *I&EC Research*, 44 (16), 6200 (2005). Invited contribution to the MILORAD P. DUDUKOVIC FESTSCHRIFT: PART 2.
14. M. Oyanader and P. Arce, "Role of Geometrical Dimensions in Electrophoresis Applications with Orthogonal Fields," *Electrophoresis*, 26, 2857 (2005).
15. E. Erdmann, M.O. Oyanader, P. Arce, "Effect of Joule Heating and of Material Voids on Free-Convective Transport in Fibrous or Porous Media with Applied Electrical Fields," *Electrophoresis*, 26, 2867 (2005).
16. M. Oyanader and P. Arce, "A New and Simpler Approach for the Solution of Electrostatic Potential Differential Equation," *Journal of Colloid and Interface Science*, 284, 315-322 (2005).
17. Locke, B.R. and P. Arce, "Applications of Self-Adjoint Operators to Electrophoretic Transport, Enzyme Reactions, and Microwave Heating Problems in Composite Media-I. General Formulation," *Chem. Eng. Sci.,* ***48*** (9) 1675 (1993).
18. Locke, B.R. and P. Arce, "Modeling Electrophoretic Transport of Polyelectrolytes in Beds of Non-Porous Particles," *Separations Technology,* **3**, 1-10 (1993).
19. Trinh, S., P. Arce, and B.R. Locke, "Effective Diffusivity of Point-Like Molecules in Isotropic Porous Media by Monte Carlo Simulations," *Transport in Porous Media*, 38 (3), 241 (2000).
20. Trinh, S., B. R. Locke, and P. Arce "Effective Diffusion Tensors of Point-Like Molecules in Anisotropic Media by Monte Carlo Simulation," *Transport in Porous Media,* 47, 279, 2002.

Past and Current Research Support (as PI/Co-PI)

Dr. Arce, during his academic career at Florida State University and Tennessee Technological University, has received and/or managed the equivalent of more than $4M in a blend of federal, state and international funding including agencies as NSF, NASA, Fulbright, State of Florida, State of Tennessee and the Government of Chile, Argentina, Saudi-Arabia, Iraq, and Brazil. Private foundations include Shell Foundation, Schlumberger Foundation, and Cumming Filtration Foundation. Illustrative examples are included below:

1. Department of Defense, DOD, "Life Modeling of Li-Ion Cells", Phase-II, $682K, Project Director, 2009x2yrs.
2. National Science Foundation, NSF, "Nanostructured Hydrogels for Macromolecular Separations," August 1, 1995 (x3yrs, with B.R. Locke, D. van Winkle, and R. Rill).
3. NATO International Science Exchange Programs, Linkage Grants, July 1, 1995 (x 2yrs, with M. Cerna, W. Finney and others).
4. National Science Foundation, NSF, "Controlled Channels in Polyacrylamide Gels for Macromolecular Separations," September 1, 1993 (x 2yrs, with B.R. Locke D. van Winkle, and R. Rill).
5. Currently, his research group has 8 graduate students, 2 undergrad students, and several key collaborators including Dr. V. Carranza (Sao Paulo, Brazil), Dr. R. Sanders, Dr. Pascal, Dr. Y. Liu, among others.

Recent Students Supervised: Thesis Major Professor and Postgraduate-Scholar Sponsor.

Recent Graduated Doctoral Students

U. Kasavajjula, (PhD, 2009)
Jennifer Pascal, (PhD, 2011).
Jyothi Simhadri, (PhD, 2012)

Jeffrey Thompson*, (PhD, 2012)
Cynthia M. Torres, (PhD Env-Sciences Program, 2012)
Parvin Golbayani*, (PhD, 2014)
Rocio Tijaro-Rojas, (PhD, 2015).
Chinyere Mbachu, (PhD, 2015)
Loggins, Lacy**,** Education Specialist Degree, TTU (2015).

Recent Graduated Masters Students:

Puttagunta, Rupesh, (2008)
Thota, Kiran, (2010)
Mbachu , Chinyere P., (2010)
Torres, Cynthia M., (2011)
Okoye, Njideka H., (2011)
Nagolu, Rajavardhan Reddy, (2011)
Loggins, Lacy*,* (2012). Continued as an Education Specialist Degree, TTU.
Cerda, Katherine, (2014). Returned to Chile.
Motamedilamouki, Abbas*, (2014). Continued as PhD in Engineering Student, TTU.
Marouf, Haifa**,** (2015). Will return as a PhD in Engineering Student, TTU.
Aljehani, Mashail, (2015). Will return as a PhD in Engineering Student, TTU.
Alexander Sherrrill*, (2015)

Recent Distinction in the Major and Senior Thesis:

Jennifer A. Pascal, (2006)
Jeffrey Thompson (2008)
Cerda, Katherine (2008)
Jessica Jones (2013)

Recent Postdoctoral Students:

Dr. Vinten Diwakar , PhD, TTU (2009-2010);
Dr. Jyothi Simhadri, PhD, TTU, 2012-13)
Dr. Jeffrey Thompson* (2012-13);
Dr. Veronica Carranza*, PhD, Technological University, Sao Paulo, Brazil (2010; Visiting Scholar, March 2014-2015)
(*) Co-advised.

Brief Overview of Technologically-Centered Scholarly Efforts:

Motivated by the Grand Challenges of the USA- National Academy of Engineering and his own scientific and engineering background, Dr. Arce's core efforts are guided by the needs within the so-called *"Applied Field Sensitive Technologies"* that (uniquely) requires of an external field as a primary driving force; this field could be an electrical, gravitational, magnetic, acoustic, and photon-based field. His recent efforts have extensively covered electrical (both low and high) fields and in the use of UV-Photon-based processes.

Dr. Arce's research largely focuses on the developing, testing and performance assessment of ***novel materials*** and ***technology innovation*** with an increasing emphasis on **Health Care Applications.** Efforts include Nanotemplated Hydrogels for clinical diagnostics, drug delivery and tissue scaffolding; Electrokinetics of the Kidney (towards an artificial kidney); Nanocomposite Hydrogels for drug purification, Pore Theory in wound healing, among others. Efforts related to *Health Care Environmental Areas* include the removal of health care products (anti-inflammation and pain-killer's drugs) from water effluents via Advanced Oxidation Techniques and Membrane-base processes. Novel materials related to **Energy Applications** include those related to high performance batteries and fuel cells.

Key concepts that permeate across the effort include the understanding of the role, description, and measure of the *Rate of Transport* (of a solute) and of the *Rate of Degradation* (of a contaminant) in *Health Care Engineering Applications*; the efforts are driven by the Body of Knowledge centered on *Electrokinetics-Hydrodynamics* (EKHD) that uses scientific and engineering principles associated with the physics of transport, (bio-) colloidal sciences, and kinetics of both chemical and biological reactions. Multiphase, Multidimensional and Multi-Scale systems are typical within the domain of these areas. A blend of analytical, computational approaches, and selected experiments drive the research. Since Dr. Arce's research is interdisciplinary, he enjoys collaborating with colleagues in Applied Mathematics, Engineering, Chemistry, and Biology/Biomedical.

Brief Overview of Pedagogically-Centered Efforts:

Dr. Arce has a long-life passion about increasing student learning efficiency and helping colleagues to become "facilitators of learning". Key to his strategy is the "Constructionist Approach to Learning" originally proposed by the co-founder and director of the MIT Multimedia Lab, Seymour Papert. Well known by his effort to understand the role of Jean Paiget's constructivist theory in conjunction with "hands on" approaches, Papert wrote the pedagogically changing book "Mindstorms" where the role of "physical" and or other instruments (such a turtle) play an important role in the "construction" of knowledge. In Papert's own words:

"Constructionism shares constructivism's connotation of learning as 'building knowledge structures' irrespective of the circumstances of the learning. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe."

Guided by these principles, Dr. Arce's efforts during the last decade have been focused on integrating learning spaces, technology and pedagogical principles to create an efficient learning environment for the students and where "instructors" are actively and energetically catalyzing the building of student knowledge. Dr. Arce with students and collaborators have "constructed" an efficient and integrative model called the "Renaissance Foundry" where the interplay of the different learning pillars (above mentioned) leads to the development of the "Da Vinci-Style" Engineer: Creative, adaptive and entrepreneur.