Christian Franck, Assistant Professor of Engineering, School of Engineering

Education

Ph.D. in Aeronautics, California Institute of Technology	2008
Dissertation Topic: "*Quantitative Characterization of 3D Deformations of Cell Interactions with Soft Biomaterials*"	
M.S. in Aeronautics, California Institute of Technology	2004
B.S., *with distinction*, Aerospace Engineering, University of Virginia	2003

Professional Appointments

Graduate Research Assistant, Aeronautics, California Institute of Technology	2003-2008
Research Engineer, Aeronautics, California Institute of Technology	2008
Postdoctoral Fellow, School of Engineering and Applied Sciences, Harvard University	2009
Assistant Professor, School of Engineering, Brown University	2009-Present

Completed Publications/Exhibitions/Performances

a. Chapters in Books

Franck, C., Maskarinec, S.A.,"Quantifying Cell Matrix Deformations in Three Dimensions", In: Mechanobiology of Cell-Cell and Cell-Matrix Interactions, Springer. New York, 2011.

b. Refereed Journal Articles

Franck, C., Bhattacharya, K., Ravichandran, G., "Characterization of Domain Walls in $BaTiO_3$ Using Simultaneous Atomic Force and Piezo Response Force Microscopy," *Applied Physics Letters*, 88, 102907 (1-3), 2006.

Carrico, I.S., Maskarinec, S.A., Heilshorn, S.C., Mock, M.L., Liu, J.C., Nowatzki, P.J., **Franck, C.**, Ravichandran, G., Tirrell, D.A., "Lithographic Patterning of Photoreactive Cell-Adhesive Proteins," *Journal of American Chemical Society*, 129, 4874-4875, 2007.

Franck, C., Hong, S., Maskarinec, S.A., Tirrell, D.A., Ravichandran, G., "Three-Dimensional Full-Field Measurements of Large Deformations in Soft Materials using Confocal Microscopy and Digital Volume Correlation," *Experimental Mechanics*, 47, 427-438, 2007.

Nowatzki, P.J., **Franck, C.**, Ravichandran, G. Tirrell, D.A., "Characterization of Mechanically Tunable Photosensitive Artificial Protein Thin Films by Nanoindentation," *Macromolecules*, 41(5), 1839-1845, 2008.

Franck, C., Maskarinec, S.A., Ravichandran, C., Tirrell, D.A., "Quantifying Cellular Traction Forces in Three Dimensions," *PNAS*, 106:22108-22113, 2009.

Franck, C., Maskarinec, S.A., Tirrell, D.A., Ravichandran, G., "Three-dimensional Traction Force Microscopy: A New Tool for Quantifying Cell-Matrix Interactions," *PLoS One*, 6(3), e:17833, 1-15, 2011.

Hemphill, M.A., Dabiri, B.E., Gabriele, S., Kerscher, L., **Franck, C.**, Goss, J.A., Alford, P.W., Parker, K.K., "A Role for Integrins and the Cytoskeleton in Blast-induced Diffuse Axonal Injury", *PLoS One*, 6(7), e:22899, 1-11, 2011.

Ryu, S., **Franck, C.,** "In vitro Hydrodynamic Lateral Force Calibration of AFM Colloidal Probes", *Langmuir*, 27 (21), pp 13390–13399, 2011.

Toyjanova, J., Bar-Kochba, E., Lopez-Fagundo, C., Hoffman-Kim, D., **Franck, C.**,"A High Resolution 3D Traction Force Microscopy Technique for Large Material Strains", *PLoS One*, accepted.

Bar-Kochba, E., Toyjanova, J., Andrews, E., Kim, K.S., **Franck, C.**,"Development a Fast Iterative Digital Volume Correlation Technique for Large Deformation Measurements", *Experimental Mechanics*, accepted.

c. Conference Abstracts

Cooper, K.R., **Franck, C.**, Kelly, R.G., "Development of an Exfoliation Test Procedure for USAF Aging Aircraft Program" Tri-Services, San Antonio, Texas, 2002 (Conference Proceedings)

Franck, C., Bhattacharya, K., Ravichandran, G., "Characterization of Domain Walls in Ferroelectrics using Atomic Force (AFM) and Piezo Response Force (PFM) Microscopy" Materials Research Society Fall Meeting, Boston, Massachussetts, 2005. (Poster)

Franck, C., Bhattacharya, K., Ravichandran, G., "Characterization of Domain Walls in Ferroelectrics using Atomic Force (AFM) and Piezo Response Force (PFM) Microscopy," Society for Experimental Mechanics Annual Conference and Exposition, Portland, Oregon, 2005 (Oral Presentation)

Franck, C., Nowatzki, P.J., Tirrell, D.A., Ravichandran, G., "Nanoindentation and Finite Element Modeling of Extracellular Matrix Proteins" Society for Experimental Mechanics Annual Conference and Exposition, St. Louis Missouri, 2006 (Conference Proceedings)

Franck, C., Hong, S., Maskarinec, S.A, Tirrell, D.A., Ravichandran, G., "Three-Dimensional Full-Field Measurements of Large Deformations in Soft Biomaterials using Confocal Microscopy and Digital Volume Correlation." ASME Applied Mechanics and Materials Conference, Austin, Texas 2007 (Oral Presentation)

Ryu, S., **Franck, C.**,"Focal Adhesion Strength and Lifetime Depend on Substrate Stiffness and Directionality of Detachment Forces." Society for Engineering Science, Ames, IA 2010 (Oral Presentation)

Franck, C., Hong, S., Maskarinec, S.A, Tirrell, D.A., Ravichandran, G., Three-dimensional Quantitative Measurements of Cells in their Surrounding Environment." Society for Engineering Science, Ames, IA 2010 (Oral Presentation)

Franck, C., "3D Quantitative Measurements of Cells in their Surrounding Environment." New England Workshop on the Mechanics and Materials of Structures, Harvard University, Cambridge, MA 2010 (Oral Presentation)

Bar-Kochba, E., Toyjanova, J., **Franck, C.**,"A New Brain Injury Model for Traumatic Brain Injury." Society for Experimental Mechanics, Mohegan Sun, CT, 2011 (Oral Presentation)

Toyjanova, J., Bar-Kochba, E., **Franck, C.**,"Dynamic Cell Behavior on Cyclically Compliant Stretched Substrates." Society for Experimental Mechanics, Mohegan Sun, CT, 2011 (Oral Presentation)

Franck, C., Hong, S., Maskarinec, S.A, Tirrell, D.A., Ravichandran, G., Three-dimensional Quantitative Measurements of Cells in their Surrounding Environment." Society for Experimental Mechanics, Mohegan Sun, CT, 2011 (Oral Presentation)

Toyjanova, J., Flores-Cortez, E., Reichner, J., **Franck, C.**,"3D Neutrophil Tractions in Changing Microenvironments", Society for Engineering Science, Atlanta, GA 2012 (Oral Presentation)

Bar-Kochba, E., Guttag, M., Subham, S., Franck, J., McNamara, K., Crisco, J., Blume, J., **Franck, C.**, "Finite Element Analysis of Head Impact in Contact Sports", Simulia Community Conference, Providence, RI, 2012 (Conference Proceeding)

Bar-Kochba, E., Guttag, M., Subham, S., Franck, J., McNamara, K., Crisco, J., Blume, J., **Franck, C.**, "Finite Element Analysis of Head Impact in Contact Sports", Applied Physics Society March Meeting, Boston, MA, 2012 (Oral Presentation)

Toyjanova, J., Flores-Cortez, E., Reichner, J., **Franck, C.**,"Determining the Effect of Dimension on Neutrophil Adhesion and Motility", Applied Physics Society March Meeting, Boston, MA, 2012 (Oral Presentation)

Estrada, J., Bar-Kochba, E., **Franck, C.**,"Developing a Failure Strain Envelope for Neurons in Uniaxial Compression", Society for Engineering Science, Providence, RI 2013 (Oral Presentation)

Bar-Kochba, E., Toyjanova, J., Andrews, E., Kim, K.S., **Franck, C.**,"Development a Fast Iterative Digital Volume Correlation Technique for Large Deformation Measurements", Society for Engineering Science, Providence, RI 2013 (Oral Presentation)

Toyjanova, J., Flores-Cortez, E., Reichner, J., **Franck, C.**,"3D Neutrophil Tractions in Changing Microenvironments", Society for Engineering Science, Providence, RI 2013 (Oral Presentation)

d. Invited Lectures

Division of Engineering, Brown University	March 2008
Biomedical Engineering Department, Columbia University	April 2008
GEM^4 Summer School, California Institute of Technology	July 2008
Polymer Seminar Series, Massachusetts Institute of Technology	April 2009
Biomedical Engineering and Biotechnology Seminars, University of Massachusetts, Dartmouth	October 2009
Graduate Seminar Series, Department of Mechanical Engineering, University of Rhode Island	April 2010
Seminar Series, Department of Mechanical Engineering, University of Michigan	November 2010
Applied Mechanics Colloquium, Harvard University	February 2011
Brain Injury and Concussion Workshop, Rhode Island Hospital	April 2011
Plenary Talk: *Concussions and Head Trauma*, Rhode Island Science Teacher Association	April 2011
MMEC Seminar Series, Massachusetts Institute of Technology	February 2011
Seminar Series, School of Public Health, Harvard University	November 2011
Seminar Series, Mechanical Science and Engineering, University of Illinois, Urbana Champaign	January 2012
Seminar Series, Mechanical Engineering and Applied Sciences, Duke University	January 2012
Society for Engineering Science, Georgia Institute of Technology, Atlanta	October 2012
American Society for Mechanical Engineering, Applied Mechanics Divison, Houston	November 2012
Seminar Series, Mechanical Engineering, Carnegie Mellon University	April 2013
Seminar Series, Max Planck Institute, Stuttgart, Germany	May 2013
Seminar Series, Rhode Island College	May 2013
NIH Cobre and Orthopaedics Research Seminar Series, Rhode Island Hospital	May 2013
Scientific Research Review Meeting, Office of Naval Research	January 2014
Mechanical and Civil Engineering Seminar Series, California Institute of Technology	January 2014

e. Journal Manuscripts in Review

Lopez-Fagundo, C., Bar-Kochba, E., Hoffman-Kim, D., **Franck, C.**,"The Role of 3D Traction Forces in Schwann Cell Motility", *Biophysical Journal*, in review.

Toyjanova, J., Flores-Cortez, E., Reichner, J., **Franck, C.**,"Matrix Dimensionality Modulates Neutrophil-Generated Tractions in a Stiffness-Dependent Manner", *PNAS*, in review.

f. Journal Manuscripts in Progress

Morse, J., Franck, J., J., Crisco, J., Franck, C., "An Experimental and Numerical Investigation of Head Accelerations due to Stick Impacts in Girls' Lacrosse", in preparation.

Bao, B., Lai, C.P., Naus, C., Toyjanova, J., **Franck, C.**, Morgan, J.R., "Pannexin1 expression resists spreading of multicellular glioma tumor spheroids", in preparation.

Franck, J., McNamara, K., Litichevskiy, Bar-Kochba, R., L., Blume, J., Crisco, J., **Franck, C.**, "A Complete Methodology for Determining Head Impacts", in preparation.

Toyjanova, J., Hannen, E., Bar-Kochba, E., Darling, E., **Franck, C.**,"Time-Dependent Material Effects on Cellular Traction Generation", in preparation.

g. Patent(s)

Bar-Kochba, E., **Franck, C.,**"DEVICE AND SYSTEM FOR MECHANICAL MEASUREMENT OF BIOMATERIAL", PCT serial # PCT/US12/69779, 2012.

Research Grants

NIH R21 Grant Award (Co-PI): "Neutrophil Migration in Three Dimensions", 2012 - 2014.

NSF EAGER (Co-PI): "The Role of Cell-Cell Forces in the Bone Cadherin Switch Model", 2013 - 2014.

Brown University Research Seed Funds (PI): "Three-dimensional Traction Mapping Distinguish Neutrophils from Healthy and Septic Donors", 2013 - 2014.

Office of Naval Research (PI): "Quantifying Post-Concussive Hypothermia Effects on the Brain using a Novel 4D TBI Cell Assay", 2013 - 2014.

Office of Naval Research (PI): "Investigation of Microcavitation as a Neuronal Damage Mechanism in Blast Traumatic Brain Injury", 2014 - 2016.

NIH COBRE Pilot Grant Award (PI): "Mapping Dynamic Changes in the 3D Microrheology of Collagen Gels in the Presence of Differentiation Stem Cells", 2014 - 2015.

Brown University Richard B. Salomon Faculty Research Award (PI): "Custom-built Mechanical Testing Device for Determining Material Properties of Soft Biomaterials", 2010 - 2011.

Rhode Island Research Alliance Collaborative Grant Award: "Development of a Multiscale Brain Injury Model for Traumatic Brain Injury", 2011 - 2012.

Haythornthwaite Research Initiation Grant (PI), "Custom-designed Uniaxial Compression Device for Measuring the Mechanical Response of Soft Biomaterials", 2011 - 2013.

Service

Organizer, Solid Mechanics Engineering Seminar Series (7 speakers per term)	2009 - 2013
A.B. concentration advisor in Engineering	2013 - present
Undergraduate advising (9 freshmen, 6 sophomore students)	2010 - present
Organizer, Co-Founder, New England Workshop for Mechanics of Materials and Structures	2009 - present
Symposia and Track Organizer, Society of Engineering Science Conference	2010, 2011, 2013
Reviewer of Peer-reviewed Scientific Journals	2009 - present
Mentor, *REU Summer Student, MRSEC*, Brown University	2010 - 2011
Mentor, *UTRA Summer Students*, Brown University	2011 - 2013
Vartan Gregorian Science Conference, GK 12 Program, Brown University	2013
NSF Bearcore Panelist, Brown University	2013

Honors and Awards

Rodman Scholar, School of Engineering and Applied Science, University of Virginia	1999-2003
NASA Virginia Space Grant Consortium Scholarship	2001
Special Institute Fellowship, California Institute of Technology	2003
Kavli Nanoscience Institute Travel Stipend	2005
Ernest E. Sechler Memorial Award in Aeronautics	2007
William F. Ballhaus Prize in Aeronautics	2009
Salomon Award, Brown University	2010
Applied Mechanics Division Haythornthwaite Research Initiation Grant Award	2011

Teaching Experience

a. Brown Courses

ENGN 2910K Cell Mechanics (enrollment 10 students)	2009
ENGN 1210 Biomechanics (enrollment 22 students)	2010-2012
ENGN 2910K Cell Mechanics (enrollment 6 students)	2011
ENGN 2320 Experimental Mechanics (enrollment 11 students)	2013

ENGN 0310 Mechanics of Solids and Structures (enrollment 57 students)	2013

b. Number of Independent Studies

Supervised 2 Independent Studies	2010
Supervised 7 Independent Studies	2011
Supervised 9 Independent Studies	2012
Supervised 4 Independent Studies	2013

c. Number of Students advised

Supervised 1 undergraduate and 2 graduate (PhD) students, and 2 postdoctoral fellows	2009
Supervised 2 undergraduate and 2 graduate (PhD) students, and 2 postdoctoral fellows	2010
Supervised 7 undergraduate and 2 graduate (PhD) students, and 1 postdoctoral fellow	2011
Supervised 9 undergraduate and 5 graduate (1 MS; 4 PhD) students	2012
Supervised 4 undergraduate and 8 graduate (3 MS; 5 PhD) students	2013

d. Number of Honors, Master's, and Ph.D. thesis directed

Supervised and directed a total of 8 undergraduate honors theses	2009 - present
Supervising a total of 6 PhD theses	2009 - present
Supervising a total of 3 Master's theses	2012 - present