BIOGRAPHICAL SKETCH

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NAME: Yossi Chait

eRA COMMONS USER NAME (credential, e.g., agency login): ychait

POSITION TITLE: Professor of Mechanical & Industrial Engineering

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
The Ohio State University, Columbus	B.S.	08/1982	Mechanical Engineering
Michigan State University, East Lansing	M.S.	08/1984	Mechanical Engineering
Michigan State University, East Lansing	Ph.D.	08/1988	Mechanical Engineering

A. Personal Statement

I have successfully completed several multidisciplinary projects involving contributions from engineering, mathematics, and medicine. The premise of such projects in general, and my K25 award in particular, is the appreciation that clinical studies often require long periods of time and great expense and typically constrained by technological capabilities and difficulties under clinically unstable circumstances. A complementary approach is to rely on high-fidelity computational models to answer “what if” questions whose answers can then lead to improved diagnostic and treatment protocols and focused clinical studies. I have led multidisciplinary and international projects, all validated by clinical studies, that resulted in novel mathematical models of human physiological systems including the thyroid gland, calcium homeostasis, hemoglobin response of end-stage kidney disease patients to erythropoiesis stimulating agents, and blood volume kinetics in a dialysate dilution protocol.

Fluid volume management is a major goal of my research, as it remains one of the most challenging aspects of HD care, with serious implications for morbidity and mortality. Current fluid management is typically guided by blood pressure, an imprecise and indirect piece of hemodynamic information about blood volume and volume overload. To this end, we have developed a novel method for the estimation of blood volume, studies absolute and relative volume changes during ultrafiltration, developing feedback-based design of ultrafiltration profiles, and are investigating the application of measuring hemodynamics parameters using non-invasive bioimpedance cardiography. The hypothesis is that the integration of the above contributions will drive the development of personalized fluid volume management protocols to achieve improved cardiovascular outcomes.

a) Schneditz D, Ribitsch W, Schilcher G, Uhlmann M, Chait Y, Stadlbauer V. Concordance of absolute and relative plasma volume changes and stability of Fcells in routine hemodialysis. Hemodial Int. 2016 Jan;20(1):120-8, PMID: 26246366, PMCID: PMC4937455.
b) Samandari H, Schneditz D, Germain MJ, Horowitz J, Hollot CV, Chait Y. Variable-Volume Kinetic Model to Estimate Absolute Blood Volume in Dialysis Patients Using Dialysate Dilution. ASAIO J. 2018 Jan/Feb;64(1):77-85. PMID: 28742531.
c) Germain MJ, Joubert J, O’Grady D, Nathanson BH, Chait Y, Levin NW. Comparison of Stroke Volume Measurements during Hemodialysis Using Bioimpedance Cardiography and Echocardiography. Hemodial Int. 2017 Aug 10. PMID: 28796425.

d) Germain M, Chait, Y, Levin NW, Minimization of Intradialytic Hypotension Using Cardiography-Guided Intervention. ClinicalTrials.gov Identifier: NCT03080441, Sponsor: Nimedical, 2017 https://www.clinicaltrials.gov/ct2/show/NCT03080441?term=NIM01&rank=1.

B. Positions and Honors

Positions and Employment

1984-1988	Research and Teaching Assistant, Mechanical Engineering Department, Michigan State University, East Lansing
1986-present	Consultant, various companies in the USA and internationally.
1988-1994	Assistant Professor, Department of Mechanical and Industrial Engineering, UMass, Amherst
1994-2002	Associate Professor, Department of Mechanical and Industrial Engineering, UMass, Amherst
1996-1006	Visiting Professor, Delft University of Technology, Delft, The Netherlands
1996-1996	Visiting Professor, Tel Aviv University, Tel Aviv, Israel
2002-2002	Academic Guest Swiss Federal Institute of Technology, ETH, Zürich, Switzerland
2002-2002	Lady Davis Fellow, the Technion, Haifa, Israel
2002-present	Professor and Co-Head of Control in Biomedical Systems Laboratory, Department of Mechanical and Industrial Engineering, UMass, Amherst.
2008-2008	Lady Davis Fellow, the Technion, Haifa, Israel
2014-present	Visiting Professor, Department of Mechanical Engineering, the Technion, Haifa, Israel
2015-present	Staff, consultant, Division of Nephrology, Department of Medicine, Massachusetts General Hospital, Boston, MA
2017-	Faculty member, Center for Personalized Health Monitoring, Institute for Applied Life Sciences, UMass, Amherst

Honors

2004	Fellow, American Society of Mechanical Engineers

C. Contributions to Science

My graduate work and early academic career centered on theory and practice of feedback control systems. My lab, funded by the National Science Foundation, led several research projects that resulted in fundamental and computational advances to the Quantitative Feedback Theory, robust multivariable control, and reset control. These results formed the basis for the MATLAB QFT Control Design Toolbox, the most widely used QFT software of its kind in industry, government, and education worldwide. It was initially marketed by the MathWorks (1995-2001) and now available as a free download from our Lab web site. Early on I have favored the application of these results in multidisciplinary projects. A collaboration with computer scientists resulted in new understandings about the role of feedback in TCP/IP network communication protocol, in particular, elucidating the cause of unexplained network oscillations. Our novel application of feedback in differentiated services has produced a US patent.

a) Chait Y, Borghesani C, Zheng Y. Single-loop QFT design for robust performance in the presence of non-parametric uncertainties. J. Dyn Sys Meas Cont. 1995 117:420-24.
b) Oldak, S, Gong WB, Hollot C, Towsley D, Misra V, Chait Y, inventors, assignees. Active queue management for differentiated services. United States patent US 7085236 B2. 2003 Nov. 20.
c) Beker O, Hollot CV, Chait, Y, Han H. Fundamental properties of reset control systems. Automatica. 2004 40(6):905-15.
d) Chait Y, Hollot CV, Misra V, Towsley D, Zhang H, Cui Y. Throughput Differentiation Using Coloring at the Network Edge and Preferential Marking at the Core, IEEE Trans Net. 2005 13(4):743-54.

In recent years, my research interest has shifted to the interface of engineering, mathematics, and medicine. My initial collaboration with an endocrinologist engineered a detailed, first of its kind computational model of the human thyroid gland. Simulation results using this model have substantiated clinical observations in iodine-deficient and iodine-excess conditions such as the Wolff-Chaikoff escape mechanism. In a collaboration with an Italian medical physicist, we developed a new algorithm dealing with the accuracy and optimal timing of activity measurements in estimating absorbed dose of radioiodine in the treatment of Graves' disease. This algorithm has been incorporated in a new software tool that is freely available and used daily by clinicians

worldwide. We have also investigated the short-term dynamics of calcium homeostasis by considering the response of the parathyroid glands to acute changes in plasma calcium concentration. We derived a new mathematical model whose key element is an asymmetric Ca-PTH reverse sigmoid relation. In the first validation of this kind, this model successfully predicted the response of an induced hypercalcemic clamp test in a clinical study.

a) Degon M, Chipkin SR, Hollot CV, Zoeller RT, Chait Y. A Mathematical Model of the Human Thyroid, Mathematical Biosciences, 2008 212(1):22-53, PMID: 18291425.
b) Merrill S, Horowitz J, Traino AC, Chipkin SR, Hollot CV, Chait Y. Accuracy and optimal timing of activity measurements in estimating the absorbed dose of radioiodine in the treatment of Graves' disease. Phys Med Biol. 2011 56(3): 557-71, PMID: 21212469.
c) Shrestha RP, Hollot CV, Chipkin SR, Schmitt CP, and Chait Y. A mathematical model of parathyroid hormone response to acute changes in plasma ionized calcium concentration in humans, Mathematical Biosciences. 2010 226(1): 46-57, PMID: 20406649.
d) Web tool: Thyroid 131I Uptake Estimation in Graves' Disease. 2012 http://pcsl.ecs.umass.edu/RAIEstimTool/index.jsp.

My current research interests, primarily funded by an active NIH K25 award, are in chronic kidney disease. The goal of this proposed research are to develop individualized anemia management protocols based on mathematical models of erythropoiesis. To this end, we have published a clinically-validated mathematical model relating hemoglobin response of end-stage kidney disease patients to erythropoiesis stimulating agents. We used this model, feedback control, and a large cohort of hemodialysis patients, to investigate the hemoglobin-cycling phenomenon observed in hemodialysis patients treated with erythropoiesis stimulating agents. This effort revealed that fixed population-wide protocols suffer a fundamental limitation, and that successful protocol must account for a patient's individual physiological responsiveness to erythropoiesis stimulating agents.

a) Chait Y, Horowitz J, Nichols B, Shrestha RP, Hollot CV, Germain MJ. Control-relevant erythropoiesis modeling in end-stage renal disease. IEEE Trans Biomed Eng. 2014 61(3):658-64, PMID: 24235247.
b) Gaweda AE, Ginzburg YZ, Chait Y, Germain MJ, Aronoff GR, Rachmilewitz E. Iron dosing in kidney disease: inconsistency of evidence and clinical practice. Nephrol Dial Transplant. 2015 30(2):187-9, PMID: 24821751, PMCID: PMC4309189.
c) Shrestha RP, Horowitz J, Hollot CV, Germain MJ, Widness JA, Mock DM, Veng-Pedersen P, Chait Y. Models for the red blood cell lifespan. J Pharmacokinet Pharmacodyn. 2016 Jun;43(3):259-74, PMID: 27039311, PMCID: PMC4887310.
d) Chait Y, Kalim S, Horowitz J, Hollot CV, Ankers ED, Germain MJ, Thadhani RI. The greatly misunderstood erythropoietin resistance index and the case for a new responsiveness measure. Hemodial Int. 2016 20(3):392-8, PMID: 26843352, PMCID: PMC4934130.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/sites/myncbi/yossi.chait.1/bibliography/46095748/public/?sort=date&direction=descending

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

4K25DK096006-04, Chait Y. (PI) 9/1/2013 – 8/31/2017
NIH-NIDDK, "The Engineering of Individualized Anemia Management Protocols""
The major goals of this study are to: (1) improvement and validation of an erythropoiesis model that the applicant has created, and, building upon this model, and (2) development of a design framework for individualized Anemia Management Protocols that address the new FDA recommendation.

Levin N.W., Chait Y., Germain M. (PI) 11/1/2016 – 10/1/2017
New NI Medical, Inc., "Minimization of Intradialytic Hypotension Using Cardiography-Guided Intervention""
The major goals of this study are to: (1) demonstrate that measurement of hemodynamic variables during hemodialysis can reduce incidence and severity of intradialytic hypotension events by subgrouping subjects based on hemodynamic response and targeted intervention for each subgroup using pressure stockings and

vasopressors, (2) validate NICaS device against Doppler echocardiography, and (3) assess the feasibility of the passive leg raising protocol and hemodynamic measurements in the determination of target weight.

Chait Y., Germain M. (PI) 10/1/2016 – 9/1/2017
Rockwell Medical, Inc., “Anemia Management Quality Assurance Project””
The major goals of this study are to: reduce (1) reduce nurse staff burden, and (2) improved hemoglobin levels in target range.

Completed Research Support

1R01DK093832, Gaweda A.E. (PI) 9/1/2012 – 7/31/2016 (subaward)
NIH-NIDDK, “Computational Approach to Personalized Anemia Management”
The major goals of this study were to: 1) identify reliable clinical markers of the erythropoietic activity of iron, 2) incorporate these markers into a dose-response model for iron and erythropoietin, 3) develop personalized dosing algorithms / guidelines for concurrent coordinated administration of erythropoietin and iron in treatment of anemia due to End Stage Renal Disease