BIOGRAPHICAL SKETCH

NAME: Skliar, Mikhail

POSITION TITLE: Professor of Chemical Engineering

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Odesa Technical University, Odesa, Ukraine	MS	05/1986	Electrical Engineering/ Control Systems
National Technical University (KPI), Kyiv, Ukraine	Candidate of Science/PhD	09/1991	Control Systems
University of Colorado, Boulder, CO	PhD	08/1996	Chemical Engineering

A. Personal Statement

I am a Professor of Chemical Engineering at the University of Utah. My educational background is in Chemical and Electrical Engineering and Applied Mathematics. I received the MSEE from Odesa State Polytechnic University and a Ph.D. degree in Control of Technical Systems from the National Technical University of Ukraine (KPI). My second doctoral degree is in Chemical Engineering from the University of Colorado/Boulder. I received several national awards, including the National Science Foundation CAREER Award and the American Heart Association Established Investigator Award. I served as an Associate Editor of the IEEE Transactions of Control Systems Technology and as a Guest Editor of the International Journal of Applied Mathematics and Computer Science. I authored over 100 research papers and patents in diverse areas, including sensor development; automatic control of biomedical treatments and devices, such as MRI-guided ultrasound tumor ablation and control ventricular assist devices; manipulation and characterization of micro- and nano-scale systems, including optical and dielectrophoretic nanoparticle manipulation and the characterization of biomolecular kinetics on a scale of single molecules; stochastic and probabilistic systems; and state and parameter estimation, optimization, and automatic control. I co-founded two start-up companies to commercialize the results of my research. My laboratory currently focuses on two district areas: 1) biophysical and molecular characterization of extracellular vesicles and their diagnostic and therapeutic applications and 2) the development of ultrasonic sensors and methods for noninvasive characterization of energy conversion components, systems, and other processes, and ultrasound enhancement of transport processes in electrochemical and other processes. Our broader interests include manipulation and characterization of micro- and nanoscale systems; stochastic processes; sensor development; state and parameter estimation, optimization, automatic control, and sensor development.

B. Positions

1984-1985 Research Engineer, Department of Artificial Intelligence, Institute of Economics, Ukrainian Academy of Sciences.
1984-1986 Research Assistant, Department of Industrial and Remote Control, Odesa Technical University.
1986-1988 Junior Scientific Fellow, Department of Industrial & Remote Control, Odeasa Technical University.
1990-1991 Lecturer, Department of Mathematical Methods of System Analysis, National Technical University/Kyiv Polytechnic Institute (KPI).
1988-1991 Senior Researcher, Department of Mathematical Methods of System Analysis, KPI.
1992-1996 Research Assistant at NASA Center for Space Environmental Health, University of Colorado.
1996-now Assistant/Associate/Full Professor, Department of Chemical Engineering, University of Utah.

Other Experience

1996-present Graduate Studies Committee, Department of Chemical Engineering, University of Utah.
2017-present University Limited Submission Review Committee.
2018-2020 University Promotion and Tenure Advisory Committee (UPTAC), University of Utah.
2008-2014 Director of Graduate Studies, Department of Chemical Engineering, University of Utah.
2011-2014 College Excellence in Teaching Committee.
2007-2013 Consolidated Hearing Committee, University of Utah.
2004-2007 Academic Senate, University of Utah.
2004-2007 University Personnel and Elections Committee.
2006-2012 University Statistics Committee.
2006-2012 Barry M. Goldwater University Scholarship Committee.
2000-2012 University Technology Review Board.
2007-2013 College Academic Appeals Committee; Committee Chair in the last year.
2001-2012 College Scholarship Committee.
1997-2000 and 2004-2007 College of Engineering Council.
Various Served as a session or member of many standing and ad hoc Department's committees, including faculty search committees; ABET Committee; Scholarship Committee; Graduate Admissions Committee; Research Committee; Computer Committee.
Ongoing Served as session chair, moderator or organizer of multiple sections and workshops of American Control Conferences; Gordon Research Conference on Statistics in Chemistry and Chemical Engineering (2003); AIChE Annual Meetings; International Congress on Hyperthermic Oncology (2004).
Ongoing Regularly serve on NSF and DOE review panels.
Ongoing Editorial & Review Board of ScienceMatters.
2011-2014 Editorial Board, *ISRN Applied Mathematics.*
2009 Member of the Program Committee, American Control Conference.
2007-2011 Editorial Board, *Open Biomedical Engineering Journal.*
2004-2007 Member, University of Utah Academic Senate.
2004 Invited member, NSF workshop on Control & System Integration of Micro- & Nano-Scale Systems.
2002-2004 Associate Editor, *IEEE Transactions of Control Systems Technology.*
1997-2098 Guest Editor, *Applied Mathematics and Computer Science.*
1990 Member of the Program Committee, IV International Industrial Control Conference.

Professional Memberships (past and present)

American Society for Exosomes and Microvesicles, Institute of Electrical and Electronics Engineers (Senior Member), IEEE Control Systems Society, American Society of Nephrology, American Institute of Chemical Engineers, American Association for the Advancement of Science, American Chemical Society, Society for Thermal Medicine (formerly North American Hyperthermia Society), Instrument Society of America, Industrial Computing Society, American Society of Engineering Education, American Institute of Aeronautics and Astronautics, Sigma Xi, American Society of Artificial Internal Organs.

Recognitions

2019 Invited Plenary Lecture at 2019 Composites Convention, Stade, Germany.
2016 Invited Plenary Lecture at SelectBio Conference on Extracellular Vesicles.
2015 Invited Plenary Lecture, Chemical Engineers in Medicine, AIChE Annual Meeting.
2012 Keynote Address, 2012 AFPM Q&A and Technology Forum.
2012 Best Paper, AIChE Annual Meeting, Session on Advanced Gasification Concepts.
2011 Plenary Lecture, I.D.G.A. Image Fusion Summit.
2010 Invited Plenary Lecture, IEEE Conference on Multisensor Fusion and Integration.
2009 ScienceDirect Top 25 Hottest Articles in Material Science, Journal of Electrostatics.
2007 ScienceDirect Top 25 Hottest Articles in Chemical Engineering/Journal of Process Control.
2005 Outstanding new research published in *Physics in Medicine and Biology.*
2002 American Heart Association Established Investigator Award.
2002 Best Paper, American Control Conference, Modeling & Control of Biological Systems.
1999 NSF CAREER Award.

1997 Best Paper, American Control Conference, On-line Monitoring and Fault Detection.
1986 MSEE with Highest Honors, Odesa Technical University.

C. Contribution to Science

1. We are the first group to systematically explore the correlation between the biophysical properties of extracellular vesicles in the range of exosomes and their surface and luminal molecular content. Our first published results in this area [a] shows that the large observed difference between geometric and hydrodynamic sizes of exosomes is caused by molecular membrane-conjugated macromolecular decoration, such as transmembrane and tethered proteins, that lead to a substantial reduction in their hydrodynamic mobility and the correspondingly large increase in the hydrodynamic diameter compared to the size of the membrane envelope observed in cryo-TEM images. Furthermore, we have shown that the innate size of hydrated exosomes is nearly spherical, contrary to common reports of their cup-shaped appearance, which we have shown to be an artifact of the sample preparation, such as exosomes desiccation on surfaces prior to SEM imaging. The additional results that are currently in the process of being summarized and published show heterogeneity of exosomes' molecular content in subpopulations characterized by several different biophysical properties [b,c] and their unexpectedly high surface activity [d], which causes their irreversible absorption at the interfaces.
    a. V. Chernyshev, R. Rachamadugu, Y.-H. Tseng, D. M. Belnap, Y. Jia, K. J. Branch, A. E. Butterfield, L. F. Pease, P. S. Bernard, and M. Skliar, "Size and Shape Characterization of Hydrated and Desiccated Exosomes," Anal. Bioanal. Chem., 407:3285-3301, 2015. PMID: 25821114.
    b. M. Skliar, V. S. Chernyshev, D. M. Belnap, G. V. Sergey, S. M. Al-Hakami, P. S. Bernard, Inge J. Stijleman, R. Rachamadugu, "Membrane proteins significantly restrict exosome mobility," Biochem. Biophys. Res. Commun., 501:1055-1059, 2018. PMID: 29777705.
    c. M. Skliar, V. S. Chernyshev, "Imaging of Extracellular Vesicles by Atomic Force Microscopy," J. Vis. Exp., 11(151):e59254, 2019. PMID: 31566613.
    d. V. Chernyshev, S. Tadjiki, S. Al-Hakami, R. Rachamadugu, I. J. Stijleman, P. S. Bernard, and M. Skliar, "Heterogonous distribution of microRNA content across the population of MCF-7 exosomes," submitted.
    e. V. Chernyshev, P. S. Bernard, and M. Skliar, "Exosomes are surface-active nanoparticles that self-assemble at the interfaces," submitted.

2. Our group was the first to demonstrate in vitro [a] and in vivo [b] the automatic control of thermal dose delivery to the deep-tissue targets during high intensity focused ultrasound ablation with the real-time MR-thermometry feedback. We were the first to show that the treatment time of thermal ablations of tumors can be systematically minimized [c] by using the proposed model-predictive automatic control of the ultrasound thermal ablation therapies. We were the first to show that the automatic control of the ultrasound beam's scanning is possible and can be used to reduce the treatment time [d]. We were also the first to demonstrate the application of the MRI thermometry in developing treatment models for the optimization and the automatic feedback control of ultrasound thermal therapies [e].

    a. D. Arora, D. Cooley, T. Perry, J. Guo, A. Richardson, J. Moellmer, R. Hadley, D. Parker, M. Skliar and R. Roemer, "MR Thermometry-Based Feedback Control of Efficacy and Safety in Minimum-Time Thermal Therapies: Phantom and In-Vivo Evaluations," Int. J. Hyperthermia, 22:29–42, 2006. PMID: 16423751.
    b. D. Arora, M. Skliar and R. Roemer, "Minimum-time thermal dose control of thermal therapies," IEEE Trans Biomed Eng., 52:191–200, 2005. PMCID: PMC3703959.
    c. D. Arora, M. Minor, M. Skliar and R. Roemer, "Control of thermal therapies with moving power deposition field," Phys Med Biol., 51:1201–1219, 2006. PMID: 16481688.
    d. R. Niu, and M. Skliar, "Identification of reduced-order thermal therapy models using thermal MR images: theory and validation," IEEE Trans. Med. Imaging, 31:1493-1504, 2012. PMCID: PMC3703956.

3. We have proposed [a] and experimentally demonstrated [b,c,d] a novel approach to noninvasive ultrasound measurements of temperature distribution and heat fluxes in solids. This approach is suitable for real-time and non-destructive temperature measurements in extreme environments and locations inaccessible to the

traditional insertion sensors. I co-founded a start-up company focused on the commercialization of this novel technology.

a. M. Skliar, K. Whitty, and A. Butterfield, "Ultrasonic temperature measurement device," US Patents 8,801,277 B2 (2014) and 9,212,956 (2015).
a. Y. Jia and M. Skliar, Ultrasonic thermometry in energy conversion processes: An oxy-fuel combustor demonstrator, submitted.
b. Y. Jia and M. Skliar, Noninvasive Ultrasound Measurements of Temperature Distribution and Heat Fluxes in Solids, Energy & Fuels, Energy Fuels, 30:4363–4371, 2016.
c. Y. Jia, V. Chernyshev, and M. Skliar, "Ultrasound measurements of segmental temperature distribution in solids: Method and its high-temperature validation," Ultrasonics, 66: 91–102, 2016. PMID: 26678789.
d. Y. Jia, A. E. Butterfield, D. A. Christensen, K. J. Whitty, and M. Skliar, "Ultrasound measurements of temperature profile across gasifier refractories: Method and initial validation," Energy & Fuels, 27:4270–4277, 2013.

4. My group was the first to demonstrate that it is possible to automatically control ventricular assist devices to maintain physiological perfusion in patients even when physiological demand is changing [a-c] as a result of different levels of physical activity and that the adaptation to varying perfusion demands can be achieved without implanted physiological demand sensors [d].

a. G. Giridharan, G. Pantalos, S.Koenig, K.Gillars, and M. Skliar, "Physiologic Control of Rotary Blood Pumps: An In-Vitro Study," ASAIO J., 50:403–409, 2004. PMID: 15497377.
b. G. Giridharan and M. Skliar, "Control Strategy for Maintaining Physiological Perfusion with Implantable Rotary Blood Pumps," Artificial Organs, 27:639–648, 2003. PMID: 12823419.
c. G. Giridharan and M. Skliar, "Non-Linear Controller for Ventricular Assist Devices," Artificial Organs, 26:980–984, 2002. PMID: 12406156.
d. G. Giridharan and M. Skliar, "Physiological control of blood pumps using intrinsic pump parameters: A computer simulation study," Artificial Organs, 30:301–307, 2006. PMID: 16643388.

5. We made several theoretical contributions to state estimation and control, including the theory of implicit Kalman filtering, the optimal estimation for the Itô-Volterra systems, and the estimation and control for systems with multiplicative disturbances.

a. H. Zhang, M. V. Basin, and M. Skliar, "Itô–Volterra optimal state estimation with continuous, multirate, randomly sampled, and delayed measurements," IEEE Trans Automatic Control, 52:401-416, 2007.
b. M. V. Basin, D. Calderon-Alvarez, and M. Skliar, "Optimal Filtering for Incompletely Measured Polynomial States over Linear Observations," Int J Adap Control Signal Processing, 22:482-494, 2007.
c. Y. Lee, M. Skliar, and M. Lee, "Analytical method of PID controller design for parallel cascade control," J. Process Control, 16:809-818, 2006.
d. M. Shamsuzzoha, M. Skliar, and M. Lee, "Design of IMC filter for PID control strategy of open-loop unstable processes with time delay," Asia-Pacific Journal of Chemical Engineering, 7:93-110, 2012.
e. M. Skliar, W Fred Ramirez, "Implicit Kalman filtering," Int J Control, 66:393-412, 1997.

6. We were the first to show that NCD kinesin, a non-processive molecular motor, has a more complex kinetic interaction with microtubules than previously thought [a]. In particular, we found that while the majority of events are consistent with the previously discovered minus-end directed power stroke of NCD occurring with ATP binding, the third of apparent power strokes are in the opposite plus-end direction. We further found that plus- and minus-directed strokes have different sizes and occur at different instants within the NCD-microtubule attachment sequence.

a. A. Butterfield, R. Stewart, C. Schmidt, and M. Skliar, "Bidirectional power stroke by NCD kinesin," Biophys J., 99:3905-3915, 2010. PMID: 21156132.

List of Published Work:
https://scholar.google.com/citations?user=MSkday8AAAAJ&hl=en

D. Teaching

Received seven Dean's Letters as a top instructor in the College of Engineering.

Courses taught

- Projects Laboratory II (CHEN 4905).
- Graduate Fluid Dynamics (CHEN 6353).
- Introduction to Research (CHEN 7753 and 7755).
- Engineering Analysis of Living Systems (CHEN 5960/6960).
- Robust Multivariable Control (CHEN 7203).
- Applied Numerical Methods (CHEN 6701).
- Process Dynamics and Control (CHEN 4203).
- Topics in Chemical Engineering (CHEN 1703).
- State Space Control Methods (CHEN 5203/6203, MEEN 5210/6210).
- Robust Multivariable Control (CHEN 7203).
- Applied Optimization Methods (CHEN 7983).
- Applied Numerical Methods (CHEN 6703).
- Multivariable Process Control (CHEN 571 and 5203).
- Projects Laboratory I (CHEN 4903).
- Special Topics: Process Identification and Time Series Analysis (CHEN 591).