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November 30, 2013

Department of Electrical Engineering
University of Washington

Dear Prof. Poovendran,

I am writing to apply for a tenure-track Assistant Professor position in the Department of Electrical Engineering at the University of Washington. I am a Ph.D. candidate in Electrical Engineering and Computer Sciences; my thesis, entitled "Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion", is supervised by Professor S. Shankar Sastry and will be submitted in May of 2014.

My expertise lies at the intersection of neuromechanical motor control, dynamic and dexterous robotics, and control/dynamical systems theory. I pursue analytical and computational techniques tailored to sensorimotor control and cyber–physical systems (CPS). In ongoing work, I apply these tools to synthesis of robot maneuvers and analysis of biological systems. In future work, I envision extending these results to enable automated design of rehabilitation programs and prosthetic devices for humans.

During my graduate work at Berkeley, I dedicated substantial effort to collaborative interdisciplinary work. As a faculty member in UW EE, I would initiate collaborations with groups studying biomechanics in the Department of Biology and rehabilitation in the Department of Rehabilitative Medicine. I would eagerly seek to contribute to the NSF ERC for "Sensorimotor Neural Engineering", for instance via a strategic element of my research program, "data–driven neuromechanical models", that enables adaptive control and reverse–engineering of gaits and grasps for humans interacting with prostheses or assistive devices.

On a personal note, I remember fondly the rigorous and enriching undergraduate education I received from your department, and I would be thrilled to return as a faculty member.

I have enclosed my curriculum vitae, statements of research and teaching goals, and my three most significant archival manuscripts. Please do not hesitate to contact me—I will gladly answer questions and provide additional information. Thank you for your consideration.

Sincerely,

Sam Burden

Sam Burden

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Education

University of California at Berkeley
Ph.D. in the Department of Electrical Engineering and Computer Sciences, May 2014 (Expected)
Adviser: Prof. S. Shankar Sastry
Thesis: Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion
Emphasis: Control Theory; Robotics; Biomechanics; Mathematics

University of Washington
B.S. with College Honors in the Department of Electrical Engineering, Cum Laude, 2008
Emphasis: Control Theory; Mathematics

Research Experience

Graduate Researcher August 2008–Present
Supervisor: Prof. S. Shankar Sastry UC Berkeley EECS
Affiliation: Center for Hybrid and Embedded Software Systems (CHESS)
Funding: NSF Graduate Research Fellowship

Graduate Researcher January 2009–Present
Supervisor: Prof. Robert J. Full UC Berkeley Integrative Biology
Affiliation: Poly–PEDAL Laboratory
Funding: ARL MAST Collaborative Technology Alliance

Research Interests

Dynamic Gaits and Dexterous Grasps: intrinsic dynamical systems techniques for model reduction, robust stability, and maneuver synthesis tailored to locomotion and manipulation.

Cyber–Physical Systems: foundational analytical and computational tools for metrization, numerical simulation, scalable optimization, and decentralized coordination.

Neuromechanics: data–driven inverse modeling applied to terrestrial biomechanics, biological and robotic motor control, diagnosis and rehabilitation of dynamic motion in humans.

Publications

Google Scholar citation count provided for publications that appeared prior to 2012.
Estimated **h–index: 6** (self–citations excluded).

Journal Publications (submitted or under review)

[S2] **S. Burden**, S. Revzen, and S.S. Sastry. Model Reduction Near Periodic Orbits of Hybrid Dynamical Systems. Submitted to IEEE Transactions on Automatic Control, 2013.

[S1] **S. Burden**, H. Gonzalez, R. Vasudevan, R. Bajcsy, and S.S. Sastry. Metrization and Simulation of Controlled Hybrid Systems. Under review in IEEE Transactions on Automatic Control, 2013.

Journal Publications

[J2] S. Revzen, **S. Burden**, J.M. Mongeau, T.Y. Moore, and R.J. Full. Instantaneous Kinematic Phase Reflects Neuromechanical Response to Lateral Perturbations of Running Cockroaches. *Biological Cybernetics* 107:179–200, 2013.

[J1] N. Napp, **S. Burden**, and E. Klavins. Setpoint regulation for stochastically interacting robots. *Autonomous Robots* 30:57–71, 2011. **25 citations**

Journal Publications (in preparation)

[P2] T.Y. Moore, **S. Burden**, S. Revzen, and R.J. Full. Adding inertia and mass to test stability predictions in rapid running insects. In prep for Biological Cybernetics.

[P1] **S. Burden**, S. Revzen, S.S. Sastry, and D.E. Koditschek. Simultaneous transitions in hybrid dynamical systems. In prep for SIAM Journal on Applied Dynamical Systems.

Conference Publications (submitted)

[C13] E. Elhamifar, **S. Burden**, and S.S. Sastry. Adaptive piecewise–affine inverse modeling of hybrid dynamical systems. Submitted to *IFAC World Congress*, 2014.

[C12] L. Ratliff, **S. Burden**, and S.S. Sastry. Genericity and structural stability of isolated differential Nash equilibria in continuous games. Submitted to *American Control Conference*, 2014.

Conference Publications (refereed)

[C11] I. Yang, **S. Burden**, S.S. Sastry, and C.J. Tomlin. Infinitesimal interconnection variation in nonlinear networked systems. *IEEE Conference on Decision and Control*, 2013.

[C10] L. Ratliff, **S. Burden**, and S.S. Sastry. Characterization and computation of local Nash equilibria in continuous games. *Allerton Conference on Communication, Control, and Computing*, 2013.

[C9] **S. Burden**, H. Ohlsson, and S.S. Sastry. Parameter identification near periodic orbits of hybrid dynamical systems. *IFAC Symposium on System Identification*, 2012.

[C8] **S. Burden**, H. Gonzalez, R. Vasudevan, R. Bajcsy, and S.S. Sastry. Numerical integration of hybrid dynamical systems via domain relaxation. *IEEE Conference on Decision and Control*, 2011.

[C7] **S. Burden**, S. Revzen, and S.S. Sastry. Dimension reduction near periodic orbits of hybrid systems. *IEEE Conference on Decision and Control*, 2011. **2 citations**

[C6] A. Hoover, **S. Burden**, X. Fu, S.S. Sastry, and R. Fearing. Bio–inspired design and dynamic maneuverability of a minimally–actuated hexapedal robot. *IEEE International Conference on Biomedical Robotics and Biomechatronics*, 2010. **32 citations**

[C5] N. Napp, **S. Burden**, and E. Klavins. Setpoint regulation for stochastically interacting robots, *Robotics: Science and Systems*, 2009. **25 citations**

[C4] **S. Burden**, J. Clark, J. Weingarten, H. Komsuoglu, and D. Koditschek. Heterogeneous leg stiffness and roll in dynamic running. *IEEE International Conference on Robotics and Automation*, 2007. **6 citations**

[C3] E. Klavins, N. Napp, and **S. Burden**. Optimal rules for programmed stochastic self–assembly, *Robotics: Science and Systems*, 2006. **37 citations**

[C2] E. Klavins, N. Napp, and **S. Burden**. Statistical dynamics of programmed self–assembly. *IEEE International Conference on Robotics and Automation*, 2006. **32 citations**

[C1] J. Bishop, **S. Burden**, E. Klavins, R. Kreisberg, W. Malone, N. Napp, and T. Nguyen. Self–organizing programmable parts. *IEEE Conference on Intelligent Robots and Systems*, 2005. **55 citations**

Symposium Abstracts

[A5] **S. Burden**, S.S. Sastry, and R.J. Full. Optimization for models of legged locomotion: estimation, synthesis, and design. *Society for Integrative and Comparative Biology*, 2014.

[A4] **S. Burden**, S. Revzen, and S.S. Sastry. From anchors to templates: Exact and approximate reduction in models of legged locomotion. *Dynamic Walking*, 2013.

[A3] S. Revzen, **S. Burden**, D.E. Koditschek, and S.S. Sastry. Pinned equilibria provide robustly stable multilegged locomotion. *Dynamic Walking*, 2013.

[A2] **S. Burden**, S. Revzen, T.Y. Moore, S.S. Sastry, and R.J. Full. Using reduced-order models to study dynamic legged locomotion: Parameter identification and model validation. *Society for Integrative and Comparative Biology*, 2013.

[A1] T.Y. Moore, S. Revzen, **S. Burden**, and R.J. Full. Adding inertia and mass to test stability predictions in rapid running insects. *Society for Integrative and Comparative Biology*, 2010.

Teaching Assistantships

Introduction to Robotics (undergrad), UC Berkeley, Fall '11.

Linear Systems (grad) — **Outstanding Teaching Award**, UC Berkeley, Fall '10.

Calculus, Differential Equations, Linear Algebra (undergrad), University of Washington, '07–08.

Professional Service

Reviewer for IEEE TAC, Robotica, IEEE CDC, IEEE ICRA, ACM HSCC

Organizer for Workshop at IEEE CDC 2012: "Control Systems in the Open World"

Member of Graduate Student Admissions Committee in EECS at UC Berkeley, 2013

Organizer for Control Theory Seminar in EECS at UC Berkeley, 2013–2014

References

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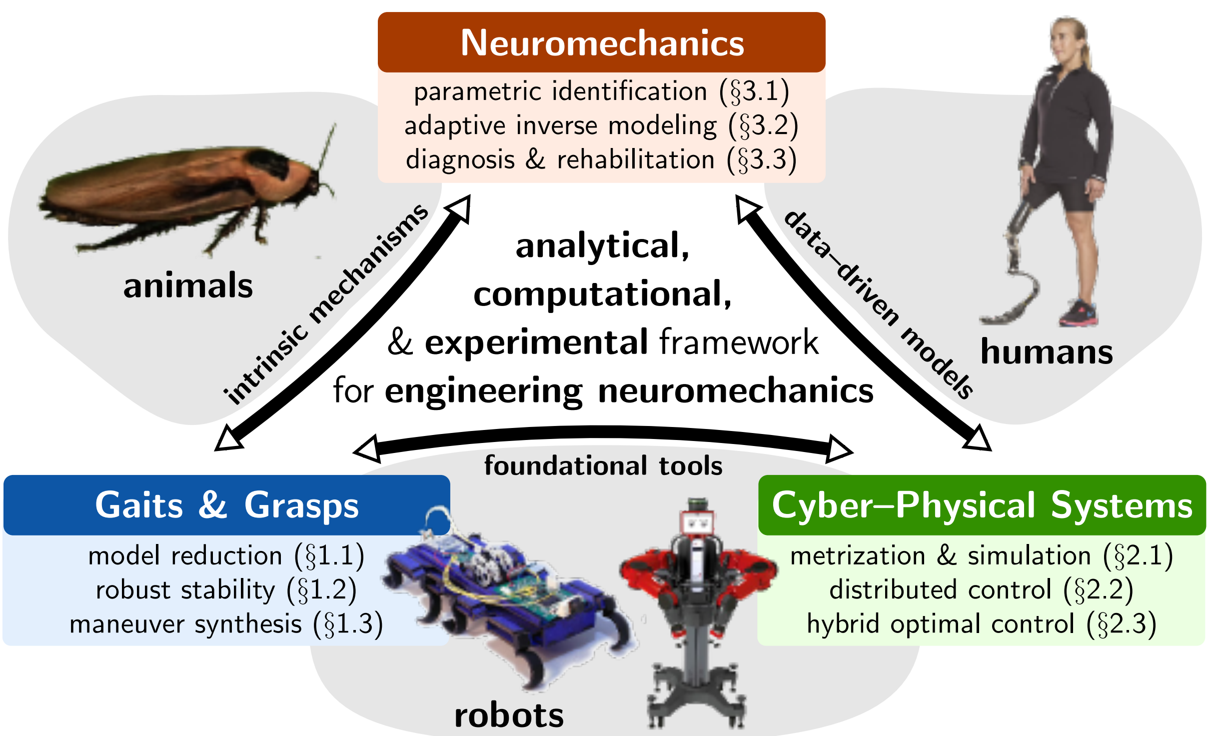
Animals excel at dynamic and dexterous volitional motor acts—gaits and grasps—whereas engineered devices are slow and clumsy. Unlike evolution, which explored and evaluated organism designs via undirected search, engineering requires systematic techniques for synthesis and validation of artifact designs. My research program targets the piecewise–defined dynamics of locomotion and manipulation as well as general tools applicable to cyber–physical systems. I emphasize generic methods and a comparative approach applicable across scale, material, and morphology. I apply these analytical and computational tools to empirically probe neuromechanics of motor control both *in vivo* using live organisms and *in vitro* with robotic surrogates. This impacts three fields:

1 **Dynamic Gaits and Dexterous Grasps**: intrinsic dynamical systems mechanisms for model reduction, robust stability, and synthesis of dynamic robot maneuvers.
2 **Cyber–Physical Systems**: foundational analytical and computational tools for metrization, numerical simulation, decentralized coordination, and scalable optimization.
3 **Neuromechanics**: data–driven inverse modeling applied to terrestrial biomechanics, biological and robotic sensorimotor control, diagnosis and rehabilitation of dynamic motion in humans.

These interdisciplinary endeavors interact synergistically, to the benefit of all three. Each component of this program provides key analytical, computational, or experimental insights that contribute to a common goal: development of a unified framework for engineering neuromechanics based on data–driven modeling, scalable controller synthesis, and intrinsic mechanisms for motor control.



1 Dynamic Gaits and Dexterous Grasps

Intermittent contact with the environment, whether for locomotion or manipulation, provides the foundation for autonomy. When a contact is established or broken, the equations of motion change discontinuously. The fundamentally piecewise–defined and discontinuous (*hybrid*) nature of these dynamics complicates their study considerably. Using intrinsic dynamical systems mechanisms in hybrid systems, I show that intermittent contact provides novel routes to model reduction and robust stabilization of rhythmic behaviors. These results provide a foundation for synthesis of robot maneuvers and analysis of animal behaviors across scale, material, and morphology.

1.1 Model reduction via intermittent contact

Empirical evidence suggests that animals collapse a large number of degrees–of–freedom (DOF) when executing a gait. Existing mathematical techniques for model reduction impose stringent assumptions that are either incompatible with the dynamics of locomotion or difficult to verify for a particular locomotor. Studying the intrinsic dynamics of locomotion, I prove that intermittent contact between limbs and terrain generically removes mechanical DOF [S2, C7, A4]. This novel mechanism for model reduction enables scalable parameter identification for locomotion (§3.1).

[S2] S. A. Burden, S. Revzen, and S. S. Sastry. Model reduction near periodic orbits of hybrid dynamical systems. Submitted to IEEE Transactions on Automatic Control (arXiv:1308.4158)

[C7] S. Burden, S. Revzen, and S. S. Sastry. Dimension reduction near periodic orbits of hybrid systems. *IEEE Conference on Decision and Control*, pp. 6116–6121, 2011

[A4] S. A. Burden, S. Revzen, and S. S. Sastry. From anchors to templates: Exact and approximate reduction in models of legged locomotion. *Dynamic Walking Meeting*, 2013

1.2 Robust stability via simultaneous impact (ongoing work)

Across scale and morphology, animals utilize gaits wherein multiple limbs impact the terrain nearly simultaneously—consider the trot of a horse or the alternating–tripod of a cockroach. The appearance of such gaits across unrelated species suggests they confer an advantage, yet classical models for such phenomena exhibit pathologies. I prove that simultaneous touchdown lends robust stability to terrestrial gaits by deriving a normal form for impact dynamics [P1, A3]. This form is also used to develop numerical algorithms for simulation (§2.1) and optimization (§2.3) of CPS.

[P1] S. Burden, S. Revzen, S. S. Sastry, and D. E. Koditschek. Simultaneous transitions in hybrid dynamical systems. In prep for SIAM Journal on Applied Dynamical Systems

[A3] S. Revzen, S. Burden, D. E. Koditschek, and S. S. Sastry. Pinned equilibria provide robustly stable multilegged locomotion. *Dynamic Walking Meeting*, 2013

1.3 Automated synthesis of dynamic robot behaviors (ongoing & future work)

Coordination of multiple limbs requires selection of a discrete sequence of contact configurations and a continuous control input. Though the continuous input can be obtained from a smooth nonlinear program for any fixed contact sequence, directly optimizing footfalls yields a mixed–integer program with combinatorial complexity. Combining the intrinsic characterization of the dynamics of gaits and grasps (§1.1–1.2) with my scalable algorithm for hybrid optimal control (§2.3) enables synthesis of continuous inputs yielding an optimal maneuver for a simulated robot [A5]. In ongoing work I aim to synthesize dynamic maneuvers over obstacles and gaits on irregular terrain.

[A5] S. Burden, S. S. Sastry, and R. J. Full. Optimization for models of legged locomotion: Estimation, synthesis, and design. *Society for Integrative and Comparative Biology Meeting*, 2014

2 Foundational Tools for Cyber–Physical Systems (CPS)

CPS are ubiquitous, emerging whenever the digital interacts with the physical. Due to their generality, it has proven difficult to develop tools that apply broadly. Exploiting the intrinsic dynamical systems mechanisms introduced in my study of intermittent contact, I derive foundational analytical and computational tools for control systems containing piecewise–defined or discontinuous dynamics (*hybrid* control systems). Gluing and metrizing disjoint pieces of state space, I developed the first provably–convergent numerical simulation algorithm for hybrid control systems. Combining nonlinear programming with differential topology and graph theory, I derive convergent algorithms for decentralized coordination. Using rectification theory of flows and maps, I pursue the first scalable algorithm for optimal control of hybrid systems containing autonomous transitions.

2.1 Metrization and numerical simulation of hybrid control systems

Piecewise–defined (*hybrid*) control systems are comprised of a disjoint collection of state spaces. State estimators and hierarchical compositions involving such systems benefit from distance metrics, but there is no natural non–trivial state space metric for hybrid control systems. By topologically gluing the distinct pieces of state space, I derived a general metric for hybrid control systems [S1, C8]. This enabled me to obtain the first proof of convergence for numerical simulation of hybrid systems that accept control inputs and admit simultaneous transitions [S1].

[S1] S. Burden, H. Gonzalez, R. Vasudevan, R. Bajcsy, and S. S. Sastry. Metrization and simulation of controlled hybrid systems. Under review in IEEE Transactions on Automatic Control (arXiv:1302.4402)

[C8] S. Burden, H. Gonzalez, R. Vasudevan, R. Bajcsy, and S. S. Sastry. Numerical integration of hybrid systems via domain relaxation. *IEEE Conference on Decision and Control*, pp. 3958–3965, 2011

2.2 Decentralized coordination in distributed control systems (ongoing & future work)

Emerging applications involving rational decision–making agents and intelligent infrastructure demand decentralized tools for distributed systems. I use dynamical systems techniques to predict the behavior arising from discrete changes in networked system dynamics [C11] and competition between selfish agents [C10]. I currently pursue applications for these tools in motor control (§3.2).

[C11] I. Yang, S. Burden, S. S. Sastry, and C. J. Tomlin. Infinitesimal interconnection variation in nonlinear networked systems. *IEEE Conference on Decision and Control*, 2013

[C10] L. J. Ratliff, S. Burden, and S. S. Sastry. Characterization and computation of local Nash equilibria in continuous games. *Allerton Conference on Communication, Control, and Computing*, 2013

2.3 Scalable optimization of hybrid dynamical systems (future work)

Optimization provides a parsimonious and systematic approach to synthesis. Techniques for hybrid systems exist when transitions are controlled or a fixed discrete transition sequence is chosen. For *autonomous* transitions triggered when a trajectory crosses into a guarded region of state space, analytical characterizations of local optima have been derived but applicable algorithms scale poorly with the number of distinct system modes. Based on my intrinsic analytical techniques (§1.1–1.2) and numerical analysis tools (§2.1), I pursue a scalable algorithm for optimal control of hybrid systems with (possibly simultaneous) autonomous transitions. This will enable optimal synthesis of robot maneuvers (§1.3) and rehabilitation programs (§3.3).

3 Data–Driven Inverse Modeling for Neuromechanics

Locomotion and manipulation arise from the interaction of a nervous system with an environment through a musculoskeletal system. Principles of such *neuromechanical* systems have been obscured by the combinatorial complexity of analytical models and computational techniques. Combining my characterization of the dynamics of gaits and grasps with the scalable computational tools I develop for CPS enables data–driven inverse modeling in neuromechanics wherein tractable models are inferred directly from empirical data. In tandem with empirical studies, this provides a unified framework to generate and test biomechanical hypotheses, probe mechanisms of motor learning and control, and derive quantitative tools for rehabilitation of gaits and grasps in humans.

3.1 Parametric system identification for terrestrial biomechanics

Generating testable neuromechanical hypothesis is challenging due to the presence of hidden states and nonlinear outcomes. Predictive models can directly generate hypotheses but must be adapted to experiments. Building on the reduced–order form I discovered for locomotion dynamics (§1.1), I proposed a scalable framework for estimation of unknown parameters in the piecewise–defined models governing locomotion [C9, A2]. In ongoing empirical work [P2] I apply this technique to probe the role of neural feedback in animals recovering from large perturbations [J2].

[P2] T. Y. Moore, S. Burden, S. Revzen, and R. J. Full. Adding inertia and mass to test stability predictions in rapid running insects. In prep for Biological Cybernetics

[J2] S. Revzen, S. A. Burden, T. Y. Moore, J.-M. Mongeau, and R. J. Full. Instantaneous kinematic phase reflects neuromechanical response to lateral perturbations of running cockroaches. *Biological Cybernetics* 107(2):179–200, 2013

[C9] S. Burden, H. Ohlsson, and S. S. Sastry. Parameter identification near periodic orbits of hybrid dynamical systems. *IFAC Symposium on System Identification*, pp. 1197–1202, 2012

[A2] S. Burden, S. Revzen, T. Y. Moore, S. S. Sastry, and R. J. Full. Using reduced-order models to study dynamic legged locomotion: Parameter identification and model validation. *Society for Integrative and Comparative Biology Meeting*, 2013

3.2 Adaptive piecewise–affine inverse modeling of motor control (ongoing & future work)

I currently pursue a data–driven framework for inverse modeling. Repeated trials from a physical system are used to construct a piecewise–affine model that reproduces experimental data. New inputs or perturbations synthesized using my scalable optimization tool (§2.3) are applied in subsequent trials, and the resulting data is used to refine the model. This process adaptively inverts the system's dynamics to yield a predictive model tailored to the experiment [C13]. I will use the result to synthesize and analyze complex motor acts in robots (§1.3) and humans (§3.3).

[C13] E. Elhamifar, S. Burden, and S. S. Sastry. Adaptive piecewise–affine inverse modeling of hybrid dynamical systems. *Submitted to IFAC World Congress*, 2014

3.3 Diagnosis, rehabilitation, and prostheses for humans (future work)

Mobility and dexterity are primary goals of motor system rehabilitation, whether the deficiency arose from acute trauma or chronic disease. Whereas current medical practice relies on qualitative assessments provided at intermittent clinic visits, the future of personalized healthcare requires tools that quantitatively assess proficiency at locomotion and manipulation, automatically synthesize a rehab program or prosthetic device, and provide training via continuous feedback to the patient. I believe that combining the tools I developed for metrization and optimization of hybrid models (§2.1,2.3) with my data–driven approach to inverse modeling (§3.1,3.2) will enable this vision of diagnosis and rehabilitation of gaits and grasps and tailored design of prostheses.

Summary

In theoretical work, I develop intrinsic analytical insights and scalable computational tools. Focusing on applications in neuromechanics, I discover and explain surprising empirical phenomena and derive specialized numerical techniques. These achievements catalyze theoretical advancements by imposing a shared set of modeling assumptions and directing effort toward problems at the intersection of robotics, biomechanics, and motor control. In ongoing and future work, I seek to:

– synthesize robust robot behaviors in real–time while exploiting intrinsic dynamics;
– model neuromechanical motor control accurately, both qualitatively and quantitatively;
– design of rehabilitation programs and prosthetic devices with minimal human intervention.

My interdisciplinary research program has the potential to provide transformative solutions to these critical problems in engineering neuromechanics.

Laboratory Facilities

Empirical validation of dynamic robot behaviors and data–driven neuromechanical models underlies my theoretical work. My needs for laboratory facilities are spanned by three workspaces.

1 **Robot fabrication and maintenance workshop**: mechatronics & electronics workstations; smart composite microstructures (SCM) manufacturing; laser cutter; 3D printers.
2 **Shared computational server**: high–performance remote–access workstation for collaborative simulation, optimization, data digitization, and visualization.
3 **Multi–modal motion capture studio**: 3D measurements of position synchronized with high–speed video and ground reaction force measurements; treadmill; robotic manipulators.

These independent facilities support interrelated experiments that cut across my research endeavors. Furthermore, each are instrumental to my teaching portfolio as described in my **Teaching Statement**.

Funding

As a faculty member, I will seek funding from: seed grants through the NSF ERC for Sensorimotor Neural Engineering; federal grants through the NSF's CAREER, Cyber–Physical Systems, and National Robotics Initiative programs; multi–institution grants involving the network of contacts at DOD research labs I have developed through five years of participation in the ARL MAST Collaborative Technology Alliance; and foundations supporting interdisciplinary work such as the Simons Foundation and Burroughs Wellcome Fund.

As the first person in my family to earn a college degree, I have a deep commitment to recruit underrepresented or disadvantaged students and to engage with society through outreach. I have delivered lectures and demonstrations at public outreach events with hundreds of attendees, led an interdepartmental group of graduate students to develop and deliver outreach activities for underrepresented K–12 minorities, and taught courses in a diverse summer math program.

Joaquin Miller Elementary, April 2013

I have mentored eight High School and College students on research projects (3 women; 5 men) and accumulated two years of teaching experience for students ranging from 15–year–old freshmen to 4th–year PhD candidates. I have consistently received strong course evaluations and have been recognized as an Outstanding Graduate Student Instructor at Berkeley.

I am confident in my ability to teach undergrad and grad courses involving control and systems theory, dynamics, robotics, mechatronics, optimization, statistics, embedded systems, and signal processing. I am eager to enhance existing courses, for instance by enabling students to build embedded systems designed for EE 472 in my **robot workshop** or by enhancing scalability and openness of EE 449 using commodity hardware, open–source software, and high–speed data acquisition tools in my **mocap studio**. In addition, I am keen to develop new courses that exemplify my commitment to outreach and the synergy of theoretical and experimental work.

Design for Society (capstone)

Motivation: In a global, tech–driven economy, engineering graduates increasingly apply their skills to diverse problems in health, policy, education, litigation, finance, and international development.

Curriculum: Students solve engineering problems in a primarily nontechnical context. Example projects include: constructing assistive devices for the elderly or disabled; developing an improved cookstove or water monitoring system for use in a developing country; delivering interactive demonstrations and lessons to supplement gradeschool science and engineering curricula.

Outcomes: community outreach; recruitment and retention of underrepresented minorities.

Data–Driven Inverse Modeling (laboratory)

Motivation: Engineering curricula focuses on analytical insights for linear systems, whereas applications of engineering in science and industry require *computational* insights for *nonlinear* phenomena.

Curriculum: Upper–division undergraduates and beginning graduates learn analytical and computational tools for data–driven inverse modeling (e.g. from control theory, statistics, optimization, and machine learning), develop experimentally–validated models for nonlinear phenomena (e.g. from robotics, biomechanics, synthetic biology, or civil infrastructure).

Facilities: data from **robot workshop** and **motion capture studio**, processing on **shared server**.

Outcomes: recruitment of undergrads for engineering research; conference publications for grads.

Systems Salon (seminar)

Motivation: Systems theory thrives on applications, and other fields benefit from systems–theoretic tools and techniques. Crossing the disciplinary boundary requires concerted effort from both sides.

Curriculum: Graduates and advanced undergraduates from across the Colleges of Engineering, Science, and Medicine prepare presentations and participate in discussions about research topics at this weekly seminar series. Specialists in systems theory present analytical and computational tools with broad applicability; practitioners of engineering, science, and medicine present datasets and empirical results in need of mathematical and statistical analysis.

Outcomes: inter–disciplinary collaboration and communication.