

Andrew J. H. Spence

CONTACT INFORMATION	Structure & Locomotion Laboratory Royal Veterinary College University of London Hatfield, Hertfordshire AL9 7TA, UK	<i>Cell:</i> +44 7726 444 601 <i>Landline:</i> +44 203 417 3878 <i>E-mail:</i> aspence@rvc.ac.uk <i>Website:</i> www.spencelab.com
RESEARCH INTEREST	The neuromechanical basis of movement; control, biomechanics, and evolution of animal locomotion; bioengineering for sensing and perturbation of freely behaving animals.	
EDUCATION	Cornell University , Ithaca, New York Doctor of Philosophy, School of Applied and Engineering Physics, August 2003 <ul style="list-style-type: none">• Dissertation Topic: “Microfabricated devices for fluidic neuroprosthetics and extracellular recording <i>in vitro</i> and <i>in vivo</i>.”• Advisors: Michael S. Isaacson, Harold G. Craighead, Ronald R. Hoy University of California at Berkeley , Berkeley, California Bachelor of Arts, Physics (Minor: Computer Science), May 1997	
CURRENT POSITION	Royal Veterinary College , Structure and Motion Laboratory, Hertfordshire, UK <i>Lecturer (Associate Professor)</i> Sept 2012 - present Leading an expanding research group that integrates experimental biology, robot and mathematical modeling, and advanced engineering to uncover general principles of biological movement.	
RESEARCH EXPERIENCE	Royal Veterinary College , Structure and Motion Laboratory, Hertfordshire, UK <i>Research Associate</i> September 2006 - September 2007 Biomechanics of equine locomotion on compliant surfaces. University of California at Berkeley , Dept. of Integrative Biology, Berkeley, CA <i>Post-doctoral Fellow</i> August 2005 - August 2006 Understanding the neuromechanics of insect locomotion: 1) insect running on compliant substrates, 2) the neural basis of antennal feedback mediated wall following behavior, 3) effect of rewriting the neural code to muscles during running and station-keeping, and 4) testing control models using a lateral ground translation perturbation. University of California at Berkeley , Division of Insect Biology, Berkeley, CA <i>Post-doctoral Researcher</i> January 2004 - August 2005 Sensory neurophysiology of antennal mechanoreception in the spider <i>Phrynus marginemaculatus</i> Marine Biological Laboratory , Woods Hole, MA MBL Summer course in Computational Neuroscience June 1999 - August 1999	
TEACHING EXPERIENCE	Royal Veterinary College , Dept. of Veterinary Basic Sciences, Hertfordshire, UK <i>Teaching and developing curricula</i> September 2006 - present Lead the <i>Comparative Animal Locomotion</i> course; further lectures, practicals and workshops for PhD students and postdocs. Inquiry, problem, and research project based teaching model. Cornell University , School of Applied and Engineering Physics, Ithaca, NY <i>Teaching Assistant</i> August 1997 - May 1998 Duties include lecturing, tutoring, grading, and leading section for two courses: A&EP333: Classical Mechanics and A&EP438: Computational Engineering Physics, junior and senior level courses. <i>Guest lecturer</i> , College of Engineering Nanobiotechnology course.	

FUNDING

Sept 2012: Biotechnology and Biosciences Research Council (BBSRC), *Foundations of Neuromechanical Systems Biology*. Principal Investigator, £812k.

June 2012: Biotechnology and Biosciences Research Council (BBSRC), Research Experience Placement. *Modelling animal gaits to understand stability, make predictions about neural control, and develop new tests for lameness and neuropathy*. Principal Investigator, £2000.

March 2011: Royal Society Research Grant *Closing the loop in running mice: an experimental platform to dissect the neural circuits underlying locomotion*. Principal Investigator, £13,900.

June 2011: Biotechnology and Biosciences Research Council (BBSRC), Research Experience Placement. *Does foot contact timing depend on visual input in mice?*. Principal Investigator, £2000.

Feb 2010: Engineering and Physical Sciences Research Council (EPSRC), Cross Disciplinary Initiative: *Bioinspired Control Architectures for Multilegged Locomotion*. Principal Investigator, £124,879.

Feb 2009: Royal Society International Travel Grant *Scientific and technological frontiers in field arboreal biomechanics*. Principal Investigator, £700.

Sep 2008: BBSrc - Industrial Case PhD Studentship *Assessment of equine locomotor biomechanics during racing using instrumented tags*. Co-Principal Investigator, 3 years, £80,000.

PROFESSIONAL EXPERIENCE

Nion Corporation, Spherical aberration corrector project, Kirkland, WA
Consultant **May 1997 - August 2001**
Developed software for automatic diagnosis of aberrations from STEM images.

MEDIA COVERAGE

See How They Run. The Daily Telegraph *Seven Magazine*. 18 November 2012.

Cell Podcast: Interview for Editorial in Size Special Issue. **Cell Podcast**. 10 May 2012.

Horse racing: Scientists say secret of success is the pack. **DiscoveryNews – AFP**. 7 March 2012.

How to predict a winner. **The Royal Society**. 7 March 2012.

How to win a horse race. **COSMOS**. Achim Eberhart, 7 March 2012.

Welcome to Robotville, Population: 20. **New Scientist Culturelab**. Celeste Biever, 1 Dec. 2011.

Robots set up home at Science Museum. **BBC News**. Rory Cellan-Jones, 5 Dec. 2011.

Gliding is quick but hard work. **Nature Newsblog**. George Wigmore, July 28th, 2011.

In Picture: Tracking Flying Lemurs. **BBC Nature**. July 28th, 2011.

Why do flying lemurs glide?. **Discover Magazine – Not Exactly Rocket Science**. Ed Yong, July 28th, 2011.

Flying Mammal Pays Price For Glides. **Scientific American – 60 Second Science**. Christopher Intagliata, July 28th, 2011.

ScienceShot: Tree Gliders Are Energy Wasters. **Science – Science Now**. Yasmin Ogale, July 28th, 2011.

Camel spiders are sticky killers. **BBC Earth News**. Matt Walker, July 8th, 2010.

“Cyber-roach” forces rethink on animal movement. **Wired.co.uk**. Duncan Geere, May 14th, 2010.

Interview and jockey feature broadcast during The Breeder's Cup. **ESPN**. Nov 8th, 2009.

Faster Horses? Study Credits Jockeys. **The New York Times**. Joe Drape, July 16th, 2009.

Secrets of Jockeying: Why Horses Go Fast. **Time.com**. Jeffrey Kluger, July 21st, 2009.

The Physics of Flesh. **Discover Magazine Blogs**, The Loom (Carl Zimmer). January 26th, 2009.

Commentary on *Acrobatic geckos steer with their tails* for **New Scientist**, March 17th, 2008.

Hang gliders. **Science** Random Samples, February 29th, 2008; 319(5867).

High-tech backpack helps reveal lemur's flying secret. Roger Highfield, **The Daily Telegraph**, February 6th, 2008.

PUBLICATIONS –
BIOLOGY

Andrew Spence and John Hutchinson. A Growing Size Synthesis. *Current Biology* (2012) **22** (9): R309-R314. <http://dx.doi.org/10.1016/j.cub.2012.03.017>

Andrew Spence, Andrew Thurman, Michael Maher, and Alan Wilson. Speed, pacing strategy and aerodynamic drafting in Thoroughbred horse racing. *Biology Letters* (2012) **Online ahead**. <http://dx.doi.org/10.1098/rsbl.2011.1120>.

Zoe Self, **Andrew Spence**, and Alan Wilson. Racehorse speed supports a power constraint to incline running and a force constraint to decline running. (2012) *Journal of Applied Physiology*. <http://jap.physiology.org/content/early/2012/05/31/japphysiol.00560.2011.abstract>.

Greg Byrnes and **A. J. Spence**. Ecological and biomechanical insights into the evolution of gliding in mammals (2011) *Integrative and Comparative Biology* **51**(6): 991-1001. <http://dx.doi.org/10.1093/icb/icr069>.

Greg Byrnes, Thomas Libby, Norman, T.-L. Lim, and **A.J. Spence**. Gliding saves time but not energy in Malayan Colugos. *Journal of Experimental Biology* **214** (2011) p 2690-2696. <http://dx.doi.org/10.1242/jeb.052993>

Simon Sponberg, **Andrew J. Spence**, Chris H. Mullens, & Robert J. Full. A single muscle's multifunctional control potential of body dynamics for postural control and running *Phil. Trans. Roy. Soc. B* **366** (2011) no. 1570 p. 1592-1605. <http://dx.doi.org/10.1098/rstb.2010.0367>

G. Byrnes, N. T-L. Lim, C. Yeong, and **A.J. Spence**. Sex differences in the locomotor behavior and ecology of a gliding mammal (*Galeopterus variegatus*) determined from animal-borne inertial sensors. *Journal of Mammology* **92** no. 2, (2011) p 444-451. dx.doi.org/10.1644/10-MAMM-A-048.1

A.J. Spence, S. Revzen, J. Seipel, C. Mullens, and R.J. Full. Insects running on elastic surfaces. *Journal of Experimental Biology* **213** (2010) p 1907-1920. <http://dx.doi.org/10.1242/jeb.042515>.

K.J. Parsons, **A.J. Spence**, R. Morgan, J.A. Thompson, and A.M. Wilson. High speed field kinematics of foot contact in elite galloping horses in training. *Equine Veterinary Journal Equine Veterinary Journal* **43** no. 2 (2011) p 216-222. <http://dx.doi.org/10.1111/j.2042-3306.2010.00149.x>.

R.H. Willemart, R.D. Santer, **A.J. Spence**, E.A. Hebets. A sticky situation: Solifugids (Arachnida, Solifugae) use adhesive organs on their pedipalps for prey capture *Journal of Ethology* **29** no. 1 (2010) p 177-180. <http://dx.doi.org/10.1007/s10164-010-0222-4>.

T. Pfau, **A.J. Spence**, S. Starke, M. Ferrari, A. Wilson. Modern Riding Style Improves Horse Racing Times. *Science* **325** (2009) p 289. <http://dx.doi.org/10.1126/science.1174605>.

A.J. Spence. Scaling in biology. *Current Biology* **19** (2009) R57-R61. <http://dx.doi.org/10.1016/j.cub.2008.10.042>.

G. Byrnes, N. T-L. Lim, and **A.J. Spence.** Take-off and landing kinetics of free-ranging Malayan colugos (*Galeopterus variegatus*). *Proceedings of the Royal Society B* (2008). <http://dx.doi.org/10.1098/rspb.2007.1684>.

A.J. Spence, H. Tan and A.M. Wilson. Accuracy of the TurfTrax Racing Data System for determination of speed and position. *Equine Veterinary Journal*, 40, (2008) 680-683. <http://dx.doi.org/10.2746/042516408X330338>.

A.J. Spence and E.A. Hebets, Anatomy and physiology of giant neurons in the antenniform leg of the amblypygid *Phrynus marginemaculatus*. *Journal of Arachnology* 34 (2006), 566-577. [Available Online](#).

A. Surlykke, J.E. Yack, **A.J. Spence,** I. Hasenfuss. Hearing in hooktip moths (Drepanidae: Lepidoptera). *Journal of Experimental Biology* 206 (2003), 2653-2663. <http://dx.doi.org/10.1242/jeb.00469>.

PUBLICATIONS –
ENGINEERING

A.J. Spence, G. Nicholson-Thomas, R. Lampe. Closing the loop in legged neuromechanics: an open-source computer vision controlled treadmill. *Journal of Neuroscience Methods* (2013), in press. <http://dx.doi.org/10.1016/j.jneumeth.2013.03.009>.

A.J. Spence. Control strategies for legged locomotion: a comparative approach. 7th European Nonlinear Dynamics Conference (ENOC 2011), Rome, Italy. <http://w3.uniroma1.it/dsg/enoc2011/proceedings/pdf/spence.pdf>.

A.J. Spence, K.B. Neeves, D. Murphy, S. Sponberg, B.R. Land, R.R. Hoy, and M.S. Isaacson, Flexible multielectrodes can resolve multiple muscles in an insect appendage. *Journal of Neuroscience Methods* 159 (2007), 116-124. <http://dx.doi.org/10.1016/j.jneumeth.2006.07.002>.

A.J. Spence, R.R. Hoy, M. S. Isaacson. A micromachined silicon multielectrode for multiunit recording. *Journal of Neuroscience Methods* 126 (2003), 119-126. [http://dx.doi.org/10.1016/S0165-0270\(03\)00075-X](http://dx.doi.org/10.1016/S0165-0270(03)00075-X).

C.D. James, **A.J. Spence,** N. Dowell, R.J. Hussein, K. Smith, H.G. Craighead, M.S. Isaacson, W. Shain, J. Turner. Extracellular Recordings from Constructed Neuronal Networks using Planar Microelectrode Arrays. *IEEE Transactions on Biomedical Engineering* 51 (2004), 1640-1648. <http://dx.doi.org/10.1109/TBME.2004.827252>.

S.T. Retterer, K.L. Smith, C.S. Bjornsson, K.B. Neeves, **A.J. Spence,** J.N. Turner, W. Shain, and M.S. Isaacson. Model neural prostheses with Integrated Microfluidics: A Potential Intervention Strategy for Controlling Reactive Cell and Tissue Responses. *IEEE Transactions on Biomedical Engineering*, 51 (2004), 2063-2073. <http://dx.doi.org/10.1109/TBME.2004.834288>.

A.P. Russo, S.T. Retterer, **A.J. Spence,** M.S. Isaacson, L.A. Lepak, M.G. Spencer, D.L. Martin, R. MacColl, J.N. Turner. Direct Casting of Polymeric Membranes into Microfluidic Devices. *Separation Science and Technology* 39 (2004), 2515-2530. <http://dx.doi.org/10.1081/SS-200026706>.

A.P. Russo, D. Apoga, N. Dowell, W. Shain, A. Turner, H. Craighead, **A.J. Spence,** S.T. Retterer, M.S. Isaacson, H.C. Hoch, J.N. Turner. Microfabricated Plastic Devices from Silicon Using Soft Intermediates. *Biomedical Microdevices* 4 (2002), 277-283. [Available Online](#).

L. Spataro, J. Dilgen, S. Retterer, **A.J. Spence,** M. Isaacson, J.N. Turner, W. Shain. Dexamethasone treatment reduces astroglia responses to inserted neuroprosthetic devices in rat neocortex. *Experimental Neurology* 194 (2005), 289-300. <http://dx.doi.org/10.1016/j.expneurol.2004.08.037>.

D.H. Szarowski, M.D. Andersen, S. Retterer, **A.J. Spence**, M. Isaacson, H.G. Craighead, J.N. Turner, W. Shain. Brain responses to micro-machined silicon devices. *Brain Research* 983 (2003), 23-35. [http://dx.doi.org/10.1016/S0006-8993\(03\)03023-3](http://dx.doi.org/10.1016/S0006-8993(03)03023-3).

- SELECTED TALKS “Fast horses... and fast robots, insects and neurotechologies: How to go fast on legs.” *Invited seminar* for the Parliamentary and Scientific Committee Seminar on *Speed*. National Science and Engineering Week. Portcullis House, Parliament, London, United Kingdom. 21st March 2013.
- “Neuromechanics and Optogenetics: Dissecting the neural and musculoskeletal contributions to locomotor control.” *Invited seminar*. Frontiers in Sport and Exercise Science and Medicine Seminar Series, Brunel University, London, 13th March 2013.
- “Foundations of Neuromechanical Systems Biology. Combining engineering, biology, and mathematics to understand how we move.” Department of Bioengineering Seminar, Temple University, Philadelphia, USA. 26th February 2013.
- Ibid.* **Kod*Lab** Research Group Meeting Seminar. School of Engineering and Applied Sciences, University of Pennsylvania, Philadelphia, USA, 25th February 2013.
- “Integrative Neuromechanics: Combining biology, engineering, and mathematics to understand how animals move.” Shriners Hospitals Pediatric Research Center, Temple University, Philadelphia, USA, 1st June 2012.
- “Integrative studies of fast locomotor behaviour.” *Invited speaker*. Locomotion Systems Science Workshop: National Science Foundation / Army Research Laboratories (USA), Washington DC, USA, 31st May 2012.
- “Insects on rubber, dogs on springs, and robots in a field: An integrative approach to discovering how animals move and making better robots.” Computer Science Department Invited Seminar, Queen Mary University of London, 21st March 2012.
- “Insects on rubber, dogs on springs, and robots in a field: An integrative approach to discovering how animals move and making better robots.” Centre for Cognitive Neuroscience and Cognitive Robotics Colloquium, University of Birmingham, Birmingham, UK. 13th March 2012.
- “Integrative Neuromechanics: Combining biology, engineering, and mathematics to understand how animals move.” Dept. of Biology Seminar, Temple University, 6th February 2012.
- “How is dog gait affected by natural rough terrain?” Society for Integrative and Comparative Biology. Charleston, SC, 3-7 January 2012.
- “Mathematical approaches to animal locomotion: past, present, and future.” Veterinary Epidemiology and Public Health Seminar, Royal Veterinary College, 21st November 2011.
- “Control strategies for legged locomotion on soft surfaces: a comparative approach” European Non-linear Oscillators Conference, 24-29 July 2011, *Invited*.
- “Starting an independent research career.” University College London Neuroscience Early Career Forum, 23rd May 2011, *Invited Speaker*.
- “Insects on rubber and dogs on springs: sensing and perturbing animals to understand the mechanics of legged locomotion.” *CFS Seminar*, Dept. of Organismal and Evolutionary Biology, Harvard University, Massachusetts, March 11th, 2011.
- Ibid.* *Boston Action Club*, Dept. of Kinesiology, Northeastern University, Boston, MA, March 10th, 2011.

Ibid. Kod*Lab Research Group Meeting, School of Engineering and Applied Science, University of Pennsylvania, Philadelphia, January 14th, 2011.

Ibid. Departmental seminar, Dept. of Biology, Temple University, Philadelphia, January 13th, 2011.

“Insects running on elastic surfaces: the role of feedforward control.” *European Science Foundation – Functional Neurobiology in Minibrains: from Flies to Robots*. Sant Feliu de Guixols, Spain, October 20th, 2010.

“Equine racing surfaces: How much do they vary, how do they affect hoof impact, and can we measure what the horse will feel?” Racecourse Association Clerks of the Course Seminar, 8th November 2010, London, UK.

“Is virtual leg stiffness a task variable for running that generalizes across posture and leg number?” Society for Experimental Biology Annual Meeting, May 2010, special session *Function and Control of Elastic Systems*. Prague, Czech Republic.

“Insects on rubber and dogs on springs: sensing and perturbing animals to understand the mechanics of legged locomotion.” *Physics Colloquium*, School of Physics and Astronomy, University of Southampton, April 30th, 2010.

“Multi-legged running in the real world: how do cockroaches, dogs, and horses handle different surfaces?” *Department of Zoology Tea Talk*, University of Cambridge, January 2010, Cambridge, United Kingdom.

“Multilegged runners in the real world: insects and horses running on hard and soft surfaces” Lauflabor (Locomotion laboratory) Group Seminar, University of Jena, September 14th, 2009, Jena, Germany.

“Insects running on elastic surfaces: The role of feedforward control” Society for Experimental Biology Annual Meeting, June 2009, Glasgow, Scotland.

“Speed, strategy, drag and drafting in Thoroughbred horse racing” Society for Experimental Biology Annual Meeting, June 2009, Glasgow, Scotland.

“What limits running speed in race horses.” Society for Integrative and Comparative Biology Annual Meeting, January 2008, San Antonio, Texas.

“Effects of substrate properties on equine locomotion.” Society for Experimental Biology Annual Meeting, March 2007, Glasgow, Scotland.

“Insect Running on Compliant Surfaces.” Society for Integrative and Comparative Biology Annual Meeting, January 2007, Phoenix, Arizona.

“Applications of Microfabricated Devices to Neuroscience and Neuromechanics.” Baskin School of Engineering Invited Seminar, January, 2006. Dept. of Electrical Engineering, University of California at Santa Cruz.

“Preliminary neuroethological studies of the whip spider *Phrynus marginemaculatus* (Arachnida, Amblypigi).” International Congress of Arachnology, July 2004, Ghent, Belgium.

“Customizing Multielectrodes for Nerve Cords.” Computation in Biological Systems invited seminar, February 2003, Montana State University, Bozeman, MN.

“Silicon Multielectrodes for In Vivo Multi-neuron Electrophysiology.” National Nanofabrication Users’ Network Annual Meeting, Stanford University, November, 2002, Palo Alto, CA.

Liedtke, A.M., Moore, S., Witte, T., **Spence, A.J.** (2012) How do animals with limited distal limb musculature use sensory feedback during locomotion? *Integrative and Comparative Biology* 52: P111.

Self, Z.t., **Spence, A.J.**, Wilson, A.M. (2012) Jump racing: do horses slow down due to a force limit? *Integrative and Comparative Biology* 52: P161.

Wilshin, S.D.; Haynes, G.C.; Reeve, M., Revzen, S. **Spence, Andrew J.** (2012) How is dog gait affected by natural rough terrain? *Integrative and Comparative Biology* 52: P198.

Wilshin, S.D., Haynes, G.C., Porteous, J., **Spence, A. J.** (2012) Describing gait transitions and the role of symmetry in control. *Integrative and Comparative Biology* 52: P198.

S. Wilshin, C.N. Kelleher, G. Byrnes, J. Seipel, **A.J. Spence** (2011) Dogs on springs: do trotting dogs adjust their virtual leg stiffness on compliant surfaces? *Integrative and Comparative Biology* 51: E152-E152.

Spence, A.J., Seipel, J., Revzen, S., Mullens, C., Yeats, K. and Full, R.J. (2009) Insects running on elastic surfaces: The role of feedforward control. *Annual Meeting of the Society-for-Experimental-Biology*, Glasgow, Scotland. pp S137-S137.

Spence, A.J., Thurman, A., Maher, M. and Wilson, A.M. (2009) Speed, strategy, drag and drafting in thoroughbred horse racing. *Annual Meeting of the Society-for-Experimental-Biology*, Glasgow, Scotland. pp S127-S127.

Spence, A.J. and Wilson, A.M. (2008) What limits running speed in race horses. *Comparative Biochemistry and Physiology Part A, Molecular & Integrative Physiology*. 48.

A.J. Spence, K. Parsons, M. Ferrari, T. Pfau, A. Wilson, and A. Thurman, Effects of substrate properties on equine locomotion. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 146 (2007), S109-S109.

A.J. Spence, S. Revzen, K. Yeats, C. Mullens, and R. Full, Insects running on compliant surfaces. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 146 (2007), S121-S121.

G. Byrnes, **A.J. Spence** and N. Lim. Locomotor biomechanics of a free-ranging gliding mammal *Cynocephalus variegatus*. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 146 (2007), S143-S144.

S. Sponberg, **A. Spence**, and R.J. Full, Testing neural control models for antenna-based tactile navigation in cockroaches. *Society for Integrative and Comparative Biology* 45 (2005), 1076-1076.

S. Revzen, J. Bishop-Moser, **A.J. Spence**, and R.J. Full, Testing Control Models In Rapid Running Insects Using Lateral Ground Translation. *Society for Integrative and Comparative Biology* 2007. Phoenix, Arizona

M. Bowtell, **A. Spence**, A. Wilson, D. Kerwin, G. Irwin and I. Bezodis. Limitation to maximal speed human sprinting - Insights from bend running and fatigue. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 146 (2007), S109-S109.

S. Sponberg, C. Mullens, R. Full and **A. Spence**. Effective fields for muscles in the neuromechanical control of running and station-keeping cockroaches. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 146 (2007), S112-S113.

(EPSRC—UK), Biotechnology and Biological Sciences Research Council (BBSRC—UK), Journal of Neuroscience Methods, Journal of Theoretical Biology, Applied Animal Behaviour Science, Microgravity – Science and Technology, The Veterinary Journal, The Journal of Experimental Zoology A

ADVISORY PANELS Engineering and Physical Science Research Council (EPSRC—UK)

MEMBERSHIPS Society for Integrative and Comparative Biology, Society for Experimental Biology

CONFERENCE
ORGANIZATION Session Chair, “Locomotion — substrates.” Society for Integrative and Comparative Biology 2012.

Session organizer, *Integration of active and passive control mechanisms in locomotion*, Society for Experimental Biology 2009.