Tingfan Wu 吳亭範

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Technical Skills

programming	Matlab, Python, Java, C/C++
robotics	humanoid locomotion, articulate body kinematics/dynamics modeling & identification, reinforcement motor learning, sensor fusion, optical motion capture, optimal control (iterative LQG), pneumatic actuators, Robotic Operating System (ROS)
computer vision	texture recognition, activity classification, facial expression analysis, support vector machines
fabrication	Solidworks, 3D printing, laser cutter, CNC, basic PCB, 8051, Arduino

Professional Experience

2015-present **Co-Founder & Chief Scientist**, UmboCV Inc..

2013-2015 **Postdoc Researcher**, P.I Jerry Pratt, Florida Institute Human Machine Cognition (IHMC).

- Integrate whole-body force-control and ICP-based walking algorithm onto Boston Dynamics Atlas humanoid. My primary focus was on low-level hydraulic force control. We won second place on DARPA Robotics Challenge (2015) and DARPA Robotic Challenge Trials (2013).
- Lead the IHMC effort porting the IHMC control/walking algorithm onto NASA's humanoid robot, Valkyrie. Besides project management, I also focused on series-elastic actuator torque control tuning and robot pose sensor processing.
- Integrate vision algorithms for drift-free robot pose estimation and automatic robot testing.

2013 **Visiting Scholar**, P.I Emanuel Todorov, University of Washington.

- Constructing model predictive controllers for humanoid robot walking and anthropomorphic robot arm manipulation

2010-2013 **Research Assistant**, P.I. Javier Movellan.

- Developed an automatic sensor **calibration** algorithm exploiting redundancy among sensors of multiple modalities. On a task calibrating 38 joint-angle potentiometers and 24 motion capture markers on a humanoid robot, the algorithm achieves 7x higher precision than manual calibration
- Designed a **semi-parametric dynamics model** which outperforms its parametric and non-parametric counterparts. The proposed model flexibly fits arbitrary observed dynamics and generalizes systematically to unobserved situation
- Created a novel **reinforcement learning framework** enabling humanoid robots to learn motor and social skills in the similar manner as we humans do

2007- 2010 **Research Assistant / Software Engineer**, P.I. Marian Bartlett / Emotient .

- Designed novel computer vision algorithms for spatiotemporal Action Unit based facial expression recognition; widely used in emotion related research; being commercialized by a startup, Emotient

2004 **Research Intern**, Siemens Corporate Research, Princeton, NJ.

- Developed software for automatic hearing aids shell customization from 3D ear canal model
- Created a high-accuracy colon polyp detector for computer tomography data

2002 - 2004 **Undergraduate Research Assistant**, P.I. Chih-Jen Lin.

- Created an efficient algorithm for probability estimation for support vector machines, now implemented in **libsvm**

Education

2013 **Ph.D. in Computer Science**, *University of California, San Diego (UCSD)*, La Jolla, CA.
Thesis: Machine Learning Algorithms for Humanoid Robot Modeling and Control
Advisor: Javier Movellan

2010 **M.Sc. in Computer Science**, *University of California, San Diego (UCSD)*, La Jolla, CA.
Research: Computer Vision – FACS-based Facial Expression Recognition
Advisor: Javier Movellan & Marian Bartlett | GPA:3.84

2004 **B.Sc in Computer Science**, *National Taiwan University (NTU)*, Taipei City, Taiwan.
Research: Probabilistic Output for Support Vector Machines (in **libsvm**)
Advisor: Chih-Jen Lin | GPA: 3.91(major)
President's Award (top 5% in class) in 2000, 2002 and 2003

Software

2004 **libsvm-prob**, extensions to a popular support vector machine library to provide probabilistic prediction in addition to original binary predictions (1800^+ citations).

2007-2011 **AULearner**, a module for Computer Expression Recognition Toolbox(CERT) for Action Unit based expression recognition.

2012-2013 **ROS-Matlab-Bridge**, a library enabling writing ROS node in Matlab (80+ downloads).

Publications

[1] Ting-Fan Wu, Chih-Jen Lin, and Ruby C Weng. Probability estimates for multi-class classification by pairwise coupling. *Journal of Machine Learning Research*, 5(Aug):975–1005, 2004. **Ting-Fan Wu**, Chih-Jen Lin, and Ruby C Weng. Probability estimates for multi-class classification by pairwise coupling. *Journal of Machine Learning Research*, 5(Aug):975–1005, 2004.

[2] Georg Wiedebach, Sylvain Bertrand, **Tingfan Wu**, Luca Fiorio, Stephen McCrory, Robert Griffin, Francesco Nori, and Jerry Pratt. Walking on partial footholds including line contacts with the humanoid robot atlas. *arXiv preprint arXiv:1607.08089*, 2016. Georg Wiedebach, Sylvain Bertrand, Tingfan Wu, Luca Fiorio, Stephen McCrory, Robert Griffin, Francesco Nori, and Jerry Pratt. Walking on partial footholds including line contacts with the humanoid robot atlas. *arXiv preprint arXiv:1607.08089*, 2016.

[3] Twan Koolen, Sylvain Bertrand, Gray Thomas, Tomas De Boer, **Tingfan Wu**, Jesper Smith, Johannes Englsberger, and Jerry Pratt. Design of a momentum-based control framework and application to the humanoid robot atlas. *International Journal of Humanoid Robotics*, 13(01):1650007, 2016. Twan Koolen, Sylvain Bertrand, Gray Thomas, Tomas De Boer, Tingfan Wu, Jesper Smith, Johannes Englsberger, and Jerry Pratt. Design of a momentum-based control framework and application to the humanoid robot atlas. *International Journal of Humanoid Robotics*, 13(01):1650007, 2016.

[4] Matthew Johnson, Brandon Shrewsbury, Sylvain Bertrand, **Tingfan Wu**, Daniel Duran, Marshall Floyd, Peter Abeles, Douglas Stephen, Nathan Mertins, Alex Lesman, et al. Team ihmc's lessons learned from the darpa robotics challenge trials. *Journal of Field Robotics*, 32(2):192–208, 2015. Matthew Johnson, Brandon Shrewsbury, Sylvain Bertrand, Tingfan Wu, Daniel Duran, Marshall Floyd, Peter Abeles, Douglas Stephen, Nathan Mertins, Alex Lesman, et al. Team ihmc's lessons learned from the darpa robotics challenge trials. *Journal of Field Robotics*, 32(2):192–208, 2015.

[5] **Tingfan Wu**, Yuval Tassa, Vikash Kumar, Javier R Movellan, and Emanuel Todorov. Stac:

Simultaneous tracking and calibration. In *Humanoids*, pages 469–476, 2013. Tingfan Wu, Yuval Tassa, Vikash Kumar, Javier R Movellan, and Emanuel Todorov. Stac: Simultaneous tracking and calibration. In *Humanoids*, pages 469–476, 2013.

[6] **Tingfan Wu**, Nicholas J Butko, Paul Ruvulo, Marian S Bartlett, and Javier R Movellan. Learning to make facial expressions. In *2009 IEEE 8th International Conference on Development and Learning*, pages 1–6. IEEE, 2009. Tingfan Wu, Nicholas J Butko, Paul Ruvulo, Marian S Bartlett, and Javier R Movellan. Learning to make facial expressions. In *2009 IEEE 8th International Conference on Development and Learning*, pages 1–6. IEEE, 2009.

[7] Yuval Tassa, **Tingfan Wu**, Javier Movellan, and Emanuel Todorov. Modeling and identification of pneumatic actuators. In *2013 IEEE International Conference on Mechatronics and Automation*, pages 437–443. IEEE, 2013. Yuval Tassa, Tingfan Wu, Javier Movellan, and Emanuel Todorov. Modeling and identification of pneumatic actuators. In *2013 IEEE International Conference on Mechatronics and Automation*, pages 437–443. IEEE, 2013.

[8] **Tingfan Wu** and Javier Movellan. Semi-parametric gaussian process for robot system identification. In *2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 725–731. IEEE, 2012. Tingfan Wu and Javier Movellan. Semi-parametric gaussian process for robot system identification. In *2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 725–731. IEEE, 2012.

[9] **Tingfan Wu**, Nicholas J Butko, Paul Ruvolo, Jacob Whitehill, Marian S Bartlett, and Javier R Movellan. Multilayer architectures for facial action unit recognition. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, 42(4):1027–1038, 2012. Tingfan Wu, Nicholas J Butko, Paul Ruvolo, Jacob Whitehill, Marian S Bartlett, and Javier R Movellan. Multilayer architectures for facial action unit recognition. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, 42(4):1027–1038, 2012.

[10] **Tingfan Wu**, Juan Artigas, Whitnet Mattson, Paul Ruvolo, Javier Movellan, and Daniel Messinger. Collecting a developmental dataset of reaching behaviors: First steps. In *IROS2011 Workshop on Cognitive Neuroscience Robotics*, 2011. Tingfan Wu, Juan Artigas, Whitnet Mattson, Paul Ruvolo, Javier Movellan, and Daniel Messinger. Collecting a developmental dataset of reaching behaviors: First steps. In *IROS2011 Workshop on Cognitive Neuroscience Robotics*, 2011.

[11] **Tingfan Wu**, Nicholas J Butko, Paul Ruvolo, Jacob Whitehill, Marian S Bartlett, and Javier R Movellan. Action unit recognition transfer across datasets. In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 889–896. IEEE, 2011. Tingfan Wu, Nicholas J Butko, Paul Ruvolo, Jacob Whitehill, Marian S Bartlett, and Javier R Movellan. Action unit recognition transfer across datasets. In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 889–896. IEEE, 2011.

[12] **Tingfan Wu**, Marian S Bartlett, and Javier R Movellan. Facial expression recognition using gabor motion energy filters. In *2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition-Workshops*, pages 42–47. IEEE, 2010. Tingfan Wu, Marian S Bartlett, and Javier R Movellan. Facial expression recognition using gabor motion energy filters. In *2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition-Workshops*, pages 42–47. IEEE, 2010.

[13] Paul Ruvolo, **Tingfan Wu**, and Javier R Movellan. Control by gradient collocation: Applications to optimal obstacle avoidance and minimum torque control. In *IEEE/RSJ International Conference on*

Intelligent Robots and Systems (IROS), pages 1173–1179. IEEE, 2012. Paul Ruvolo, Tingfan Wu, and Javier R Movellan. Control by gradient collocation: Applications to optimal obstacle avoidance and minimum torque control. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 1173–1179. IEEE, 2012.

[14] Karan Sikka, **Tingfan Wu**, Josh Susskind, and Marian Bartlett. Exploring bag of words architectures in the facial expression domain. In *Computer Vision–ECCV 2012. Workshops and Demonstrations*, pages 250–259. Springer, 2012. Karan Sikka, Tingfan Wu, Josh Susskind, and Marian Bartlett. Exploring bag of words architectures in the facial expression domain. In *Computer Vision–ECCV 2012. Workshops and Demonstrations*, pages 250–259. Springer, 2012.

[15] Fei Long, **Tingfan Wu**, Javier R Movellan, Marian S Bartlett, and Gwen Littlewort. Learning spatiotemporal features by using independent component analysis with application to facial expression recognition. *Neurocomputing*, 93:126–132, 2012. Fei Long, Tingfan Wu, Javier R Movellan, Marian S Bartlett, and Gwen Littlewort. Learning spatiotemporal features by using independent component analysis with application to facial expression recognition. *Neurocomputing*, 93:126–132, 2012.

[16] Gwen Littlewort, Jacob Whitehill, **Tingfan Wu**, Ian Fasel, Mark Frank, Javier Movellan, and Marian Bartlett. The computer expression recognition toolbox (cert). In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 298–305. IEEE, 2011. Gwen Littlewort, Jacob Whitehill, Tingfan Wu, Ian Fasel, Mark Frank, Javier Movellan, and Marian Bartlett. The computer expression recognition toolbox (cert). In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 298–305. IEEE, 2011.

[17] Gwen Littlewort, Jacob Whitehill, Ting-Fan Wu, Nicholas Butko, Paul Ruvolo, Javier Movellan, and Marian Bartlett. The motion in emotion?a cert based approach to the fera emotion challenge. In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 897–902. IEEE, 2011. Gwen Littlewort, Jacob Whitehill, **Ting-Fan Wu**, Nicholas Butko, Paul Ruvolo, Javier Movellan, and Marian Bartlett. The motion in emotion?a cert based approach to the fera emotion challenge. In *Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on*, pages 897–902. IEEE, 2011.

[18] Jacob Whitehill, Ting-fan Wu, Jacob Bergsma, Javier R Movellan, and Paul L Ruvolo. Whose vote should count more: Optimal integration of labels from labelers of unknown expertise. In *Advances in neural information processing systems*, pages 2035–2043, 2009. Jacob Whitehill, Ting-fan Wu, Jacob Bergsma, Javier R Movellan, and Paul L Ruvolo. Whose vote should count more: Optimal integration of labels from labelers of unknown expertise. In *Advances in neural information processing systems*, pages 2035–2043, 2009.

[19] Marian Bartlett, Gwen Littlewort, **Tingfan Wu**, and Javier Movellan. Computer expression recognition toolbox. In *Automatic Face & Gesture Recognition, 2008. FG'08. 8th IEEE International Conference on*, pages 1–2. IEEE, 2008. Marian Bartlett, Gwen Littlewort, Tingfan Wu, and Javier Movellan. Computer expression recognition toolbox. In *Automatic Face & Gesture Recognition, 2008. FG'08. 8th IEEE International Conference on*, pages 1–2. IEEE, 2008.

[20] Marian Bartlett, Gwen Littlewort, Jacob Whitehill, Esra Vural, **Tingfan Wu**, Kang Lee, Aytül Erçil, Müjdat Cetin, and Javıer Movellan. Insights on spontaneous facial expressions from automatic expression measurement. *Dynamic Faces: Insights from Experiments and Computation*, 2006.

Marian Bartlett, Gwen Littlewort, Jacob Whitehill, Esra Vural, Tingfan Wu, Kang Lee, Aytül Erçil, Müjdat Cetin, and Javıer Movellan. Insights on spontaneous facial expressions from automatic expression measurement. *Dynamic Faces: Insights from Experiments and Computation*, 2006.

[21] Ian Fasel, Paul Ruvolo, **Tingfan Wu**, and Javier Movellan. Infomax control for social robots. 2009. Ian Fasel, Paul Ruvolo, Tingfan Wu, and Javier Movellan. Infomax control for social robots. 2009.

[22] Yiwen Wang, **Tingfan Wu**, Garrick Orchard, Piotr Dudek, Michele Rucci, and Bertram E Shi. Hebbian learning of visually directed reaching by a robot arm. In *Biomedical Circuits and Systems Conference, 2009 (BioCAS 2009).*, pages 205–208. IEEE, 2009. Yiwen Wang, Tingfan Wu, Garrick Orchard, Piotr Dudek, Michele Rucci, and Bertram E Shi. Hebbian learning of visually directed reaching by a robot arm. In *Biomedical Circuits and Systems Conference, 2009 (BioCAS 2009).*, pages 205–208. IEEE, 2009.

[23] **Tingfan Wu** and Javier Movellan. Simultaneous motor and sensory learning for imitation. In *2012 IEEE International Conference on Development and Learning and Epigenetic Robotics (ICDL)*, pages 1–2. IEEE, 2012. Tingfan Wu and Javier Movellan. Simultaneous motor and sensory learning for imitation. In *2012 IEEE International Conference on Development and Learning and Epigenetic Robotics (ICDL)*, pages 1–2. IEEE, 2012.

Presentations

2011 **"Cross Database Action Unit Recognition Transfer"**, *Facial Expression Recognition Analysis Challenge 2011*, Santa Barbara, CA, (Second Place Winner Talk).

2009 **"A Practical Guide to Support Vector Machines"**, *a general introduction talk to SVMs presented multiple times in NSF iSLC meeting 2008, UCSD TDLC bootcamp 2009, and Telluride Neuromorphic Workshop 2009*.

2006 **"Cafeteria Vision – an automatic dish identification and amount measurement system"**, *UCSD All Graduate Student Symposium*.

2006 **"Ranking by Stealing Human Cycles"**, *Workshop in Machine Learning Summer School 2006*, Taipei, Taiwan.

2000 **"The Colorful Liquid Crystal Filter"**, *International Science and Engineering Fair 2000*, Detroit, IL, (Fourth Award, ranked 7/157).

Academic Service

2011-2013 **Reviewer**, *International Conference on Robotics and Automation*.

2012 **Communication Chair**, *IEEE International Conference on Development and Learning*.

2008 **Student Committee**, *UCSD CSE Ph.D Admission Committee*.

2006-2007 **Reviewer**, *IEEE Transactions on Knowledge and Data Engineering*.

2007 **Reviewer**, *IEEE Transactions on Neural Networks*.

Other Experiences

2004 - 2006 **Information System Officer**, R.O.C Air Force Academy, Kaohsiung, Taiwan.

- Lead a team of 12 people delivering 24hr services to base-wide intranet and 1500+ PCs
- Developed a network anomaly detector using support vector machines on netflow data
- Trained soldiers without technical experience to diagnose computer problems by customized SOPs and statistical issue tracking systems; sped up the throughput by an order of magnitude

Additional Skills

languages English (proficient) Mandarin Chinese (native), Taiwanese (native)