Dear Prof. Swanson,

I hope this email finds you doing great! I really enjoyed your fantastic seminar at Columbia University last Thursday! We are all impressed by your new approach to treating brain tumors.

This is Tony from the Dept. of Biomedical Engineering at Columbia University. I am going to finish up my second-year postdoc training here by the end of June and seeking another postdoc position to make me better prepared for my future research plan. My field of interest is a combination of medical image analysis and numerical simulation, and I find myself extremely interested in the position in your prestigious lab.

During both my PhD and postdoc training, my research area is closely related to processing the CT and MRI images for computational modeling. We need to segment the bone tissue from the background and the trabecular tissue (porous) from the cortical tissue (dense). Basically, my jobs were to 1) prepare specimens for CT scanning; 2) reconstruct and process the images to extract the structural parameters (3D images of trabecular bone microstructure) and prepare the images for further finite element analysis; 3) perform finite element modeling; and 4) post-modeling data processing and analysis. Frequently, we need to look at the topological features, like pattern and connectivity of the bone images or the calculated highly stressed regions and size, type, and orientation of the constructing elements, and compare these parameters to the mechanical predictions from the modeling. When dealing with these images and data, I gained ample experience in programming with Matlab, C/C++, Fortran, IDL, and Linux shell scripting. Except for the imaging analysis and modeling experience, I was also involved in setting up a microindentation testing machine to measure the bone tissue properties in the microscopic level (with an accuracy up to 10 nanometers), and gained experience in mechanical design, motion control, closed-loop feedback control, and LabVIEW programming.

I definitely find working in your research lab a very unique opportunity for me to do my postdoc. I really hope I can develop my career along this path. Thank you very much for your time. I am looking forward to hearing your supportive opinions.

Best regards,

Tony

Xiutao Tony Shi

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Education and Training

Postdoc Research Scientist in Dept. of Biomedical Engineering, **Columbia University**, New York, NY, Jul. 2010 – Jun. 2012.

Ph.D. in Orthopaedic Biomechanics (GPA: 3.7/4.0), **University of Notre Dame**, Notre Dame, IN, May 2010.
Dissertation title: "Effects of architecture on microdamage susceptibility in trabecular bone", Advisor: Dr. Glen L. Niebur.

B.S. in Thermodynamics (GPA: 3.6/4.0), **University of Science and Technology of China**, Hefei, Anhui, China, Jul. 2004.
Thesis title: "Simulation of temperature and solute concentration distribution of cryoprotective agent solution during freezing process", Advisors: Dr. Gang Zhao and Prof. Liqun He.

Research Interest

- Imaging by μCT, HR-pQCT, and μMRI
- Biomedical image processing and analysis
- Large-scale, nonlinear finite element analysis (FEA) and parallel computing
- Data mining and processing
- Design and setup of mechanical testing device

Research Experience

- Processed and analyzed the μMRI images of distal tibia and distal radius to differentiate patients with or without spine fractures. *Apr. 2012, Columbia University.*
- Took the X-ray, analyzed the X-ray images of, and cut the tibia, radius, and L1 bones for mechanical testing for the clinical whole bone mechanics project. *Apr. 2012, Columbia University.*
- Collected bone specimens from human femoral bone at femoral neck, greater trochanter, and lesser trochanter for μCT scanning to identify the anatomical location dependence of the grayscale values or mineralization of cortical tissue and trabecular tissue. *Mar. 2012, Columbia University.*
- Compared the images obtained by the μCT machine in the bone bioengineering lab and those by the larger μCT machine at Exponent® (Philadelphia, PA) to study the beam-hardening effects and limitations of μCT machines. *Feb. 2012, Columbia University.*

- Investigated the effects of the applied boundary conditions on the back-calculated trabecular bone tissue properties and determined the proper boundary conditions to mimic *in vivo* mechanical loading conditions. *Oct. 2011 – Jan. 2012, Columbia University.*
- Tested one whole vertebral body model with over 60 million elements and overcame the challenges of applying the proper boundary conditions on the irregular, curvy, and porous bone image surfaces (for grant renewing. This model takes 2048 CPUs 4.5 hours to finish). *Aug. 2011 – Oct. 2011, Columbia University.*
- Examined the effects of using heterogeneous tissue properties – scale the tissue moduli from μCT image grayscale values – on the prediction in trabecular bone mechanical properties. *Dec. 2010 – May 2011, Columbia University.*
- Developed the mechanical testing device – microindentation tester – to determine the bone tissue properties on the microscopic level. *Sep. 2010 – Sep. 2011, Columbia University.*
- Installed, maintained, and added features to the large-scale parallel computing software Olympus developed by our collaborator Mark Adams on the national Linux cluster Texas Advanced Computing Center (TACC). *Jul. 2010 – now, Columbia University.*
- Determined the effects of tissue constitutive model and geometric nonlinearity on computational modeling of trabecular bone using a general purpose Finite Element Analysis Program (FEAP). *Sep. 2009 – May 2010, University of Notre Dame.*
- Identified the failing modes in trabecular bone microstructure under compressive overloads along two orthogonal directions by quantifying the yielded tissue regions on different trabecular types and orientations. *Dec. 2008 – Nov. 2009, University of Notre Dame.*
- Investigated the role of trabecular microstructure during microdamage formation and identified the yielded tissue regions in trabecular rods predicted by FEA to be correlated to the experimentally measured microdamage in trabecular bone by locating the yielded tissue regions with respect to trabecular type and orientation. *Jun. 2008 – Sep. 2009, University of Notre Dame.*
- Studied the morphologies of the predicted yielded tissue regions in trabecular bone under orthogonal overloads through a fabric tensor based study to determine the failure mechanisms in trabecular microstructure. *May 2007 – Jun. 2008, University of Notre Dame.*
- Analyzed the predicted strain distribution in trabecular bone microstructure under on-axis compression by fitting the data into a Weibull's probabilistic model and determining the parameters using the optimization tools in MATLAB. *Feb. 2006 – May 2007, University of Notre Dame.*
- Modified an in-house nonlinear FEA code and adopted a bilinear tensile-compressive asymmetric tissue yield criterion to simulate the experimental on-axis loading of trabecular bone specimens. *Mar. 2005 – Feb. 2006, University of Notre Dame.*
- Simulated the solute concentration and temperature distribution in a multi-component system with phase changes of a cryoprotective solution during a freezing process (undergraduate thesis project). *Feb. 2004 – Jun. 2004, University of Science and Technology of China.*

Publications

- **Shi, X**, Zhou, B, Adams, MF, Guo, XE, "Effects of nonlinear heterogeneous models on apparent behaviors of trabecular bone", in preparation.
- **Shi, X**, Zhou, B, Adams, MF, Sanyal, A, Keaveny, TM, Guo, XE, "Effects of boundary conditions on back-calculated trabecular tissue modulus and predicted apparent properties", in preparation.
- **Shi, X**, Liu, XS, Wang, X, Guo, XE, and Niebur, GL, "Type and orientation of yielded trabeculae during overloading of trabecular bone along orthogonal directions", *J Biomech*, 2010;43(13):2460-6.
- **Shi, X**, Liu, XS, Wang, X, Guo, XE, and Niebur, GL, "Effects of trabecular type and orientation on microdamage susceptibility in trabecular bone", *Bone*, 2010;46(5):1260-6 (**selected as cover paper**).
- **Shi, X**, Wang, X, and Niebur, GL, "Effects of loading orientation on the morphology of the predicted yielded regions in trabecular bone", *Ann Biomed Eng*, 2009;37(2):354-62.

Conference Presentations

Podium

- Wang, J, Zhou, B, **Shi, X**, Liu, XS, and Guo, XE, "Bone mineral density (BMD) of individual trabeculae in human trabecular bone", *ORS 2012 Annual Meeting*, Feb. 4-7, 2012, San Francisco, CA.
- Wang, J, Zhou, B, **Shi, X**, Liu, XS, and Guo, XE, "Bone mineral density (BMD) of individual trabeculae in human trabecular bone", *ASBMR 2011 Annual Meeting*, Sep. 16-20, 2011, San Diego, CA.
- **Shi, X**, Liu, XS, and Niebur, GL, "A computational study of microdamage susceptibility in trabecular bone", *17th Annual Symposium on Computational Methods in Orthopaedic Biomechanics*, Feb. 21, 2009, Las Vegas, NV.
- **Shi, X**, and Niebur, GL, "Effects of external loading on the morphology of the yielded regions in trabecular bone", *2008 Summer Bioengineering Conference*, Jun. 25-29, 2008, Marco Island, FL.
- **Shi, X**, and Niebur, GL, "Investigating the relationships between trabecular architecture and failure using FEA and fabric tensor", *ORS 2008 Annual Meeting*, Mar. 2-5, 2008, San Francisco, CA.
- **Shi, X**, and Niebur, GL, "Relation between microdamage accumulation and fabric in trabecular bone", *ASME Applied Mechanics and Materials Conference*, Jun. 3-7, 2007, Austin, TX.

Poster

- **Shi, X**, Zhou, B, Adams, MF, and Guo, XE, "Boundary conditions in nonlinear μCT image based finite element modeling do not affect predictions in yield strength of human trabecular bone", *ORS 2012 Annual Meeting*, Feb. 4-7, 2012, San Francisco, CA.

- Zhou, B, Wang, J, **Shi, X**, Liu, XS, Guo, XE, "Anatomic variations of the plate-rod microstructure in human trabecular bone", *ORS 2012 Annual Meeting*, Feb. 4-7, 2012, San Francisco, CA.
- Ural, A, Zhou, B, **Shi, X**, Shane, E, Guo, XE, " Evaluation of distal forearm fracture risk using HR-pQCT imaging and cohesive finite element modeling", *ORS 2012 Annual Meeting*, Feb. 4-7, 2012, San Francisco, CA.
- **Shi, X**, Liu, XS, and Niebur, GL, "Effects of trabecular type and orientation on tissue level yielding in trabecular bone", *ORS 2009 Annual Meeting*, Feb. 22-25, 2009, Las Vegas, NV.
- **Shi, X**, and Niebur, GL, "Investigating the relationships between trabecular architecture and failure using FEA and fabric tensor", *ORS 2008 Annual Meeting*, Mar. 2-5, 2008, San Francisco, CA.

Skills

System administration

- Five-year experience of maintaining Linux/Unix workstations in research labs.

Programming languages and data analysis tools

- Linux scripting, Fortran, IDL, MATLAB, and C/C++.

Other software

- Abaqus, ITK, AVS (Advanced Visual Systems), VisIt, AutoCAD, Pro/E, SAS, KaleidaGraph, JMP, and Photoshop.

References

- **Glen L. Niebur**, Ph.D., Associate Professor, Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN. Tel: (574) 631-3327. Email: gniebur@nd.edu
- **Ryan Roeder**, Ph.D., Associate Professor, Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN. Tel: (574) 631-7003. Email: rroeder@nd.edu
- **X. Edward Guo**, Ph.D., Professor of Biomedical Engineering, Columbia University, New York, NY. Tel: (212) 854-6196. Email: exg1@columbia.edu
- **X. Neil Dong**, Ph.D., Assistant Professor, Health and Kinesiology, University of Texas at Tyler, Tyler, TX. Tel: (903) 565-5615. Email: ndong@uttyler.edu
- **Leo Q. Wan**, Ph.D., Assistant Professor, Biomedical Engineering, Rensselaer Polytechnic Institute, Troy, NY. Tel: 518-276-2505. Email: wanq@rpi.edu