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Engineering & Scientific Consulting

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Professional Profile

Dr. Pak's background is in mechanical engineering with a focus on machine design, manufacturing, and optics. He has experience in developing machines and instruments from the design phase through final testing and documentation. Past projects have ranged from automated micropipette pullers to perfusion systems for 3D cell culture. His optics experience mostly focused on building new types of microscopes, but he is also familiar in techniques such as CT scanning, confocal microscopy, and two-photon microscopy.

Prior to joining Exponent, Dr. Pak obtained his Ph.D. from the Massachusetts Institute of Technology in mechanical engineering. His thesis work revolved around tool development for in vivo neuroscience, specifically in automating labor-intensive surgery and developing new types of microscopes to image neuronal activity at high speeds in 3D volumes. This work involved designing parts in SolidWorks and AutoCAD, as well as developing custom software in LabVIEW and MATLAB.

Dr. Pak also has extensive machine shop experience, including being a point of contact at the M.I.T. Center for Bits and Atoms machine shop. He also has experience in tools typically found in neuroscience labs such as vibratomes and cryostats. Additionally, he has served as a teaching assistant for the undergraduate mechanical design course at Georgia Tech (ME 2110).

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Massachusetts Institute of Technology (MIT), 2018

M.S., Mechanical Engineering, Georgia Institute of Technology (Georgia Tech), 2012

B.S., Mechanical Engineering, Georgia Institute of Technology (Georgia Tech), 2010

Languages

Russian

Publications

Piatkevich KD, Jung EE, Straub C, Linghu C, Park D, Suk HJ, Hochbaum DR, Goodwin D, Pnevmatikakis E, Pak N, Kawashima T, Yang CT, Rhoades JL, Shemesh O, Asano S, Yoon YG, Freifeld L, Saulnier JL, Riegler C, Engert F, Hughes T, Drobizhev M, Szabo B, Ahrens MB, Flavell SW, Sabatini BL, Boyden ES. A robotic multidimensional directed evolution approach applied to fluorescent voltage reporters. Nature Chemical Biology. 2018;14(4): 352-360.

Chang J-B, Chen F, Yoon Y-G, Jung EE, Babcock H, Kang JS, Asano S, Suk H-J, Pak N, Tillberg PW, Wassie A, Cai D, Boyden ES. Iterative expansion microscopy. Nature Methods. 2017;14(6): 593-599.

Phaneuf CR, Pak N, Saunders DC, Holst GL, Birjiniuk J, Nagpal N, Culpepper S, Popler E, Shane AL, Jerris R, Forest CR. Thermally multiplexed polymerase chain reaction. Biomicrofluidics. 2015;9(4):044117.

Pak N, Siegle JH, Kinney JP, Denman DJ, Blanche RJ, Boyden ES. Closed-loop, ultraprecise, automated craniotomies. Journal of Neurophysiology. 2015;113(10): 3943-3953.

Prevedel R, Yoon Y-G, Hoffmann M, Pak N, Wetzstein G, Kato S, Schrödel, Raskar R, Zimmer M, Boyden ES, Vaziri A. Simultaneous whole-animal 3D-imaging of neuronal activity using light-field microscopy. Nature Methods. 2014;11(7): 727-730.

Saunders DC, Holst GL, Phaneuf CR, Pak N, Marchese M, Sondej N, McKinnon M, Forest CR, Rapid, quantitative, reverse transcription PCR in a polymer microfluidic chip. Biosensors and Bioelectronics. 2013;44: 222-228.

Phaneuf CR, Oh K, Pak N, Saunders DC, Conrardy C, Landers JP, Tong S, Forest CR. Sensitive, microliter PCR with consensus degenerate primers for Epstein Barr virus amplification. Biomedical Microdevices. 2013;15(2): 221-231.

Pak N, Saunders DC, Phaneuf CR, Forest CR. Plug-and-play, infrared, laser-mediated PCR in a microfluidic chip. Biomedical Microdevices. 2012;14(2): 427-433.

Pak N, Dergance MJ, Emerick MT, Gagnon EB, Forest CR. An Instrument for controlled, automated production of micrometer scale fused silica pipettes. ASME Journal of Mechanical Design. 2011;133(6):061006-061006-5.

Phaneuf CR, Pak N, Forest CR. Modeling radiative heating of liquids in microchip reaction chambers. Sensors and Actuators A: Physical. 2011;167(2): 531-536.

Presentations

Chang J-B, Chen F, Yoon Y-G,Jung EE, Babcock H, Kang JS, Asano S, Suk H-J, Pak N,Tillberg PW, Wassie A, Zhuang S, Boyden ES. 20-nm resolution imaging of brain circuitry by next-generation expansion microscopy. Poster presentation, Neuroscience 2016, San Diego, CA, 2016.

Yoon Y-G, Pak N, Freifield L, Henninger MA, Deguchi J, Savidis N, Boyden ES. Sparse reconstruction light-field microscopy for high-resolution 3d-imaging of neuronal activity. Poster presentation, Neuroscience 2015, Chicago, IL, 2015.

Yoon Y-G, Prevedel R, Hoffmann M, Pak N, Wetzstein G, Kato S, Schrödel, Raskar R, Zimmer M, Boyden ES, Vaziri A. Simultaneous whole-animal 3D-imaging of neuronal activity using light-field microscopy. Neuroscience 2014, Washington, DC, 2014.

Pak N, Kinney JP, Boyden ES. Automation of brain surgery: Towards automation of In vivo Neuroscience. Poster presentation, Neuroscience 2013, San Diego, CA, 2013.

Pak N, Phaneuf CR, Saunders DC, Forest CR. Simultaneous amplification of multiple DNA targets with optimized annealing temperatures. Talk, Proceedings of the Biomedical Engineering Society (BMES) 2012 Annual Meeting, Atlanta, GA, 2012.

Holst GL, Saunders DC, Phaneuf CR, Pak N, Forest CR. Sensitive, open-loop, rapid, laser PCR system

using transient thermal analysis, optimization, and environmental control. Poster presentation, Proceedings of the Biomedical Engineering Society (BMES) 2012 Annual Meeting, Atlanta, GA, 2012.

Phaneuf CR, Oh K, Pak N, Saunders DC, Conrardy C, Landers JP, Tong S, Forest CR. Sensitive, microliter PCR with degenerate primers for respiratory virus detection and discovery. Poster presentation, Proceedings of the Biomedical Engineering Society (BMES) 2012 Annual Meeting, Atlanta, GA, 2012.

Pak N, Holst GL, Phaneuf CR, Saunders DC, Forest CR. Control schemes for microfludic viral DNA/RNA amplification. Talk, Proceedings of the 27th Annual Meeting of the American Society for Precision Engineering, San Diego, CA, 2012.

Phaneuf CR, Pak N, Saunders DC, Forest CR. Rapid, independently controlled polymerase chain reaction via multiplexed laser radiation. Poster presentation, Proceedings of the 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS), Seattle, WA, 2011.

Phaneuf CR, Pak N, Forest CR. Modeling and design of a microscale multiplexed temperature control system. Poster presentation, Proceedings of the 26th Annual Meeting of the American Society for Precision Engineering, Denver, CO, 2011.

Pak N, Phaneuf CR, Kodandaramaiah SB, Forest CR. Modulation of electromagnetic radiation using a dot matrix printer. Poster presentation, Proceedings of the 25th Annual Meeting of the American Society for Precision Engineering, Atlanta, GA, 2010.

Pak N, Dergance MJ, Emerick MT, Gagnon EB, Forest CR. An instrument for controlled, automated, continuous pulling of sub-micrometer fused silica pipettes. Talk, Proceedings of the 25th Annual Meeting of the American Society for Precision Engineering, Atlanta, GA, 2010.

Phaneuf CR, Pak N, Forest CR. Rapid, low-cost, microfluidic thermocycler for high-throughput genetic diagnostics, Talk, Proceedings of the ASME 2010 Summer Bioengineering Conference (SBC 2010), Naples, FL, 2010.

Peer Reviewer

Scientific Reports