Ravikiran "Joseph" Singapogu, Ph.D.

CONTACT INFORMATION	520 Rhodes Engineering Research Center Clemson, SC 29634	864-650-4144 joseph@clemson.edu

RESEARCH INTERESTS

- Virtual and Augmented Reality Medical Simulators
- Haptic Devices for Medical Applications
- Novel Sensors to Measure Skilled Clinical Performance
- Perceptual Optimization in Medical Robotics

EDUCATION

Clemson University, Clemson, SC

Ph.D., Bioengineering, August 2012
- Dissertation title: *"A Novel Haptic Simulator for Evaluating and Training Salient Force-based Skills for Laparoscopic Surgery"*
- Advisors: Prof. Timothy C. Burg and Prof. Karen J.L. Burg

M.S., Electrical Engineering, May 2007
- Thesis title: *"Comparative Study of Haptic and Visual Feedback for Kinesthetic Training Tasks"*
- Advisors: Prof. Timothy C. Burg and Prof. Samuel T. Sander

Jawaharlal Nehru Technological University, Hyderabad, India

B.Tech., Electrical and Electronics Engineering, June 2004

RESEARCH EXPERIENCE

Assistant Research Professor — January 2013 to present
Department of Bioengineering, Clemson University
Supervisor: Prof. Karen J.L. Burg and Prof. Guigen Zhang.

Embedded Scientist — January 2013 to present
Department of Surgery, Greenville Health System
Supervisor: David L. Cull, M.D.

Postdoctoral Scholar — August 2012 to December 2012
Department of Electrical and Computer Engineering, Clemson University
Supervisor: Prof. Timothy C. Burg

This position was facilitated by the *National Science Foundation's* Innovation Corps program, where I served as the Entrepreneurial lead for our 3-member team.

Research Assistant — Aug 2008 to Aug 2012
Department of Bioengineering, Clemson University
Supervisors: Prof. Timothy C. Burg and Prof. Karen J.L. Burg.

HONORS

National Institutes of Heath *K01* award
Awarded a five-year (2016-2021), $712,000 grant for developing simulation methods for hemodialysis cannulation.

Grand Challenges Canada (with Canadian National Institutes of Health)
Selected as a *Rising Star in Global Health*, January 2013; grant declined.

National Science Foundation Innovation Corps
Awarded best final presentation among 27 country-wide teams.

REFEREED JOURNAL PUBLICATIONS

1. **Singapogu RB**, Smith DE, Long LO, Burg TC, Pagano CC, Burg KJL. "Objective Differentiation of Force-Based Laparoscopic Skills Using a Novel Haptic Simulator." *Journal of Surgical Education*. 2012 Nov; 69(6): 766–773.

2. **Singapogu RB**, DuBose S, Long LO, Smith DE, Burg TC, Pagano CC, Burg KJL. "Salient haptic skills trainer: initial validation of a novel simulator for training force-based laparoscopic surgical skills." *Surgical Endoscopy*. 2013 May; 27(5):1653–1661.

3. **Singapogu RB**,, Long LO, Burg TC, Pagano CC, Smith DE, Kwartowitz D, Burg KJL. "Examining the learning curve on a novel haptic simulator for laparoscopic surgical skills." *International Journal of Computer Assisted Radiology and Surgery*. Jun 1; 8 (Suppl 1)(1): S337–395.

4. **Singapogu RB**, Long LO, Smith DE, Burg TC, Pagano CC, Prabhu VV, Burg KJL. "Simulator-Based Assessment of Haptic Surgical Skill: A Comparative Study." *Surgical Innovation*, vol. 22, no. 2, pp. 183–188, Apr. 2015.

5. **Singapogu RB**, Pagano CC, Burg TC, Dorn PG, Zacharia R, Lee DB. "Perceptually Salient Haptic Rendering for Enhancing Kinesthetic Perception in Virtual Environments." *Journal of Multimodal User Interfaces*, vol. 8, no. 3, pp. 319–331, 2014.

6. **Singapogu RB**, Burg TC, Burg KJL, Smith DE, Eckenrode AH, "A perspective on the role and utility of haptic feedback in laparoscopic skills training." *Critical Reviews in Biomedical Engineering*: 42 (3–4)

REFEREED CONFERENCE PUBLICATIONS

1. **Singapogu RB**, Sander ST, Burg TC, Lee DB. "A Five DOF Haptic Rendering Algorithm Using Multiple Contact Points." *IEEE Southeastcon* 2008. pp. 262–267.

2. **Singapogu RB**, Sander ST, Burg TC, Cobb WS. "Comparative Study of Haptic Training versus Visual Training for Kinesthetic Navigation Tasks." *Stud Health Technol Inform*. 2008;132: 469–471.

3. **Singapogu RB**, Pagano CC, Burg TC, Burg KJL. "Perceptual Metrics: Towards Better Methods for Assessing Realism in Laparoscopic Simulators." *Stud Health Technol Inform*. 2011;163: 588–590.

4. **Singapogu RB**, Pagano CC, Burg TC, Burg KJL, Prabhu VV. "Role of Haptic Feedback in a Basic Laparoscopic Task Requiring Hand-eye Coordination." *Stud Health Technol Inform*. 2011;163: 591–593.

5. Long L, **Singapogu RB**, DuBose S, Arcese G, Altenhoff B, Burg T, Pagano C. "A Haptic Simulator for Training Force Skill in Laparoscopic Surgery." *The Interservice–Industry Training, Simulation & Education Conference (I/ITSEC)*. NTSA; 2012.

6. **Singapogu RB**, Smith DE, Altenhoff BM, Long LO, Bontreger R, Pagano CC, Burg TC, Burg KJL. "Haptic Tasks for Physical Laparoscopic ("Box") Trainers to Differentiate Surgeon Skill." *Stud Health Technol Inform*. 2012;173: 475–477.

7. **Singapogu RB**, Smith DE, Altenhoff BM, Long LO, Prabhu VV, Pagano CC, Burg TC, Burg KJL. "Assessing Surgeon and Novice Force Skill on a Haptic Stiffness Simulator for Laparoscopic Surgery." *Stud Health Technol Inform*. 2012; 173: 469–474.

8. Long LO, **Singapogu RB**, Arcese G, Smith DE, Burg TC, Pagano CC, Burg KJL. "A Haptic Simulator to Increase Laparoscopic Force Application Sensitivity." *Stud Health Technol Inform.* 2013; 184: 273–275.

9. **Singapogu RB**, Kerr CM, Eidt JF, Pagano CC, Burg TC, Smith DE, Burg KJ. "Endovascular Seldinger Needle Placement: A Simulator for Examining Haptic Skills." *Medicine Meets Virtual Reality 21: NextMed/MMVR21.* 2014;196: 384–386.

10. **Singapogu RB**, Kavathekar T, Eidt JF, Groff RE, Burg TC. "A Novel Platform for Assessment of Surgical Suturing Skill: Preliminary Results." *Medicine Meets Virtual Reality 22: NextMed/MMVR22.*, vol. 220, p. 375, 2016.

11. **Singapogu RB**, Jagannathan A, Nagarajan N, Moody C, Zhang G, Cull DL. "A Capacitance-Based Sensor for Hemodialysis Cannulation Training: A Proof-of-Concept Study." *Medicine Meets Virtual Reality 22: NextMed/MMVR22.*, vol. 220, p. 379, 2016.

12. Long LO, Pagano CC, **Singapogu RB**, and Burg TC, "Surgeon's Perception of Soft Tissue Constraints and Distance-to-Break in a Simulated Minimally Invasive Surgery Task," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, vol. 60, no. 1, pp. 1600–1604, Sep. 2016.

13. Kavathekar T, Kil I, Groff RE, Burg TC, Eidt JF and **Singapogu RB**, "Towards Quantifying Surgical Suturing Skill with Force, Motion and Image Sensor Data" *IEEE Conference on Biomedical Health Informatics*, Feb. 2017, *Accepted for publication*

14. Kil I, Jagannathan A, **Singapogu RB** and Groff RE, "Development of Computer Vision Algorithm towards Assessment of Suturing Skill" *IEEE Conference on Biomedical Health Informatics*, Feb. 2017, *Accepted for publication*

PAPERS IN PREPARATION

1. **Singapogu RB**, Burg TC, Pagano CC, Romero KM, Kil I and Hartman LS. "A Force and Motion Platform for Measuring Fundamental Open Vascular Surgical Skills."

FUNDING

1. **NIH K01 Career Development Award**, "CanSim: A novel simulator for training cannulation skills in dialysis care", $712,000, September 2016 - September 2021.

   Role: PI; *Transdisciplinary grant to develop novel simulation methods for hemodialysis cannulation*

2. **SC MedTranstech**, "Defining Surgical Quality in Dialysis Access: A RAND/UCLA Appropriateness Study", $68,000[$13,500], October 2014 - October 2015.

   Role: Co-I; *We used the RAND/UCLA method to achieve recommendation for 4500 patient characteristic scenarios defining optimal vascular access type based on patient characteristics.*

3. **Grand Challenges Canada (with Canadian National Institutes of Health)**, "Affordable Simulators for Assessment and Training of Surgical Skill", $116,000

   Role: PI; *grant declined by PI due to international terms issues*

4. **National Science Foundation *Innovation Corps***, $50,000

   Role: Entrepreneurial Lead ; collaborated with Dr. Tim Burg (PI) on idea generation, preliminary data, approach and wrote major sections of proposal

GRANT WRITING

Unfunded

1. **NIH/NIBIB R15**: *Validation of Novel Haptic Interfaces for Force-based Surgical Skills Assessment*; Role: Co–PI, received a score of 38 during first review.

2. **NIH/NIBIB R03**: *A Simulation-based Platform for Measuring the Fundamentals of Open Vascular Surgical Skills*; Role: Co–PI, in partnership with Greenville Hospital System.

3. **NSF/IIS**: *CHS: Small: Uncovering Perceptual Parameters for Haptic Skills Training*; Role: Co–PI, in partnership with Greenville Hospital System.

4. **USIEF Obama-Singh Initiative**: *Collaborative Development of a Novel Surgical Skills Curriculum using Affordable Simulators*; Role: Co–PI, $197,170; partners: Greenville Hospital System and Christian Medical College, India.

5. **NIH/NIBIB R21**: *Validation of a Perceptual Theory-Based Approach for Quantifying Surgical Skills*; Role: Co–I, $416,000; partners: Greenville Hospital System and Carolinas Medical Center, NC.

6. **NSF/IIS**: *CHS: Medium: Biologically Inspired Algorithms for Haptic Breaking Perception of Real and Virtual Materials*; Role: Co–PI, $1,100,000; partners: Greenville Hospital System.

7. **DOD/TATRC**: *A Universal System for Defining, Evaluating and Comparing Fidelity of Military Virtual Tissue Applications.*; Role: Co–PI, $900,514; partners: Greenville Hospital System.

TEACHING

ECE 307–Basic Electrical Engineering
Served as teaching assistant for Dr. Tim Burg.
Tutored students, graded exams and developed online course material.

ECE 495–Senior Design
Served as "customer" by providing specifications for device and control design.
Mentored students and co-ordinated with other TAs for grading.

BIOE 4910–Creative Inquiry
Led structured research to design a medical simulator prototype.
Mentored undergraduate and graduate students in research exposure.

STUDENT MENTORING

- Irfan Kil [Ph.D.]
- Anand Jagannathan [M.S.]
- Naren Nagarajan [M.S.]
- Karla Romero [M.S.]
- Kumar Prateek [M.S.]
- Ron Zacharia [M.S.]
- Varun Prabhu [M.S.]
- Ryan Bontreger [M.S.]
- Charlie Kerr [B.S.]
- Nina Arcese [B.S.]
- Allison Manhard [B.S.]
- Billy Few [B.S.]

Selected talks

1. *School of Computing, Departmental Seminar Series*, Clemson University, November 2016

2. *Medical Education Days*, Greenville Hospital System, March 2014

3. *Medicine Meets Virtual Reality* Conference, February 2013, Newport Beach, CA

4. *NSF Innovation Corps* Panel, October 2012, Atlanta, GA

5. Mechatronics *Seminar*, ECE and ME Dept., September 2012, Clemson, SC

6. *NSF Innovation Corps* Final Team Presentation, August 2012

7. *Christian Medical College* Seminar, February 2012, Vellore, India

Professional Service

Reviewer
The New England Journal of Medicine
IEEE Access
IET Science, Measurement and Technology
IEEE Transactions on Human–Machine Systems
International Journal of Computer Assisted Radiology and Surgery

Memberships
Institute of Electrical and Electronics Engineers (IEEE)
Association of Surgical Education (ASE)
Biomedical Engineering Society (BMES)