

1. Most Significant Contributions:

Combining my training in Surgery and Kinesiology, I took human factors principles to surgical education and technology innovation. Specifically, I study physician and surgeon' behaviors in the interaction with various healthcare instruments, examine their abilities and limitations in the stressful work environment. The goal of my studies is to enable surgeon, either as an individual or working in a team, to perform effectively so that patients received exceptional healthcare service when undergoing hospital visits. Knowing that increasing healthcare procedures are performed under video guidance, my recent research is focused on surgeons' performance in teleoperation. Eye- and motion-tracking devices have been used in my research to examine difference in eye-hand coordination between experts and novices. Evidence has been applied to the design of new training curriculum with simulation. Results have been published in medical journals and cited by surgeons and scientists.

1) **Eye-tacking and its application in surgery**

Akins MS, Tien, G, Zheng B, et al, (2013) What do surgeons see: eyegaze sensors for surgery applications, *Surgical Innovation* 20(3):241-8.

Zheng B, et al. (2011) Surgeon's vigilance in the operating room. *American Journal of Surgery*, 201(5):667-71 (RCPSC grant on gaze training)

Jiang X, Atkins MS, Tien G, Bednarik R, & **Zheng B**. Capturing eye blinks from video-based eye-tracking. *CHI 2014*, In Press, SIGCHI Best of CHI **Honorable Mention Award** (Jiang: PhD student)

2) **Surgical tool design and evaluation**

Martinec DV, Zheng B, et al (2010). Tradeoff between flexibility and maneuverability: task performance with articulating laparoscopic instruments. *Surgical Endoscopy*, 23 (12): 2697-2701 (Martinec was my RA, NOSCART Research Grant)

Spaun GO, Zheng B, et al. (2009) Bimanual coordination in NOTES: Comparing conventional dual-channel endoscope, the R-scope and a novel direct drive system. *Gastrointestinal Endoscopy (GIE)*, 69(6):e39-45. (Dr. Spaun was a post-doc, NOSCART Research Grant)

3) **Remote manipulation with tool**

Zheng B & MacKenzie CL (2009) A comparison of human performance in grasping virtual objects by hand and with tools of different length ratios. In: *Proceedings of 53rd Human Factors and Ergonomics Society(HFES)* 1156-60 (Thesis Research, Funded by NSERC and MSFHR).

Zheng B & MacKenzie CL (2007) Kinematics of reaching and grasping with a tool. In: *Proceedings of 51st. HFES Conference* 1353-7. (Thesis Research, Funded by NSERC and MSFHR);

Zheng B & MacKenzie CL (2007) The control strategy for degrees of freedom in remote prehension with a tool. In: *Proceedings of 51st. HFES conference* 1358-62. (Thesis Research, Funded by NSERC and MSFHR)

4) **Surgical team and team training**

Zheng B, Panton ONM, Al-Tayeb TA, Meneghetti, AT, Qayumi AK, Panton ONM (2012) Impact of Surgical Team Size on Intraoperative Performance: Data from 2 Canada Hospitals, *Canadian Journal of Surgery*, 55(6):371-6

Zheng B, et al. (2008) An observation on surgery-related activities between surgeon and nurse during laparoscopic surgery. *The America Journal of Surgery* 197(4):497-502. (Legacy RAC Grant)

Zheng B, et al (2007) Building an efficient surgical team using a bench model simulation: construct validity of the legacy inanimate system for endoscopic team training (LISETT), *Surgical Endoscopy*, 22(4): 930-7 (SAGES Research Grant)

5) **Workload assessment of surgeon**

Zheng B, et al. (2012) Quantifying Mental Workloads of Surgeons in Performing NOTES Procedures, *Surgical Endoscopy*, 26(5):1352-8

Zheng B, et al. (2010) Measuring mental workload during the performance of advanced laparoscopic tasks. *Surgical Endoscopy*. 24(1):45-50.

2. Research Contributions and Practical Applications

Articles in refereed publications (HQP):

1. He W, Ni S, Chen G, Jiang X, **Zheng B** (2014) The composition of surgical teams in the operating room and its impact on surgical team performance in China. *Surgical Endoscopy* 2013 Dec 6. [Epub ahead of print]
2. Jiang X, **Zheng B**, Tien G, Atkins MS (2013). Pupil response to precision in surgical task execution. *Stud Health Technol Inform.*184:210-4.
3. Tien G, Atkins MS, Jiang X, Khan RS, **Zheng B** (2013). Identifying Eye Gaze Mismatch during Laparoscopic Surgery. *Stud Health Technol Inform.*184:453-7.
4. Atkins MS, Tien G, **Zheng B**, Khan RS, Meneghetti AT, (2012) What do surgeons see: eyegaze sensors for surgery applications, *Surgical Innovation* 20(3):241-8.
5. Jiang X, Tien G, Huang D, **Zheng B**, & Atkins MS (2013). Capturing eye blinks from video-based eye-tracking. *Behavioral Research Methods*, In Press, DOI: 10.3758/s13428-012-0294-x
6. Cassera MA, **Zheng B**, Swanström LL (2012) Data-based self-study guidelines for the Fundamentals of Laparoscopic Surgery (FLS) examination, *Surgical Endoscopy* 26(12):3426-9
7. Cassera MA, **Zheng B**, Spaun GO & Swanström LL, (2012) Optimizing surgical approach for natural orifice transluminal endoscopic procedures, *Surgical Innovation*, 19(4):433-7
8. **Zheng B**, Jiang X, Tien G, Meneghetti AT, OMN Panton, Atkins MS (2012). Workload assessment of surgeons: correlation between NASA TLX and blinks. *Surgical Endoscopy.*26(10): 2746-50
9. Qayumi AK, Donn S, **Zheng B**, Young L. Dutton J. Adamack M. Cheng A. (2012) BC Interprofessional Model for Simulation in Interprofessional Health Education: A Network of Simulation Sites, *Simulation in Healthcare*, 2012 7(5): 295-307
10. Khan RS, Tien G, Atkins MS, **Zheng B**, Panton ON, Meneghetti AT (2012) Analysis of eye gaze: Do novice surgeons look at the same location as expert surgeons during a laparoscopic operation? *Surgical Endoscopy.* 26(12):3536-40
11. Meneghetti AT, Pachev G, **Zheng B**, OMN Panton, Qayumi K (2012), Objective Assessment of Laparoscopic Skills: Dual-Task Approach, *Surgical Innovation*, 19(4):452-9
12. **Zheng B**, Panton ONM, Al-Tayeb TA, Meneghetti, AT, Qayumi AK, Panton ONM (2012) Impact of Surgical Team Size on Intraoperative Performance: Data from 2 Canada Hospitals, *Canadian Journal of Surgery*, 55(6):371-6
13. **Zheng B**, Erwin R, Cassera MA, Lee Gynsung, Martinec DV, Panton ONM, Park A. Swanström LL. (2012) Quantifying Mental Workloads of Surgeons in Performing NOTES Procedures, *Surgical Endoscopy*, 26(5):1352-8
14. **Zheng B**, Swanström LL, Meneghetti A, Panton ON, Qayumi AK (2011) Quantifying surgeon's contribution to team effectiveness on a mixed team with a junior surgeon. *Surgery.*149(6):761-5.
15. **Zheng B**, Tien G, Atkins SM, Meneghetti AT, Qayumi AK & Panton ONM (2011) Surgeon's vigilance in the operating room. *American Journal of Surgery*, 201(5):667-71
16. Hur HC, Arden D, Dodge LE, **Zheng B**, Ricciotti HA (2011) Fundamentals of Laparoscopic Surgery: A surgical skills assessment tool in gynecology. *Journal of Society of Laparoendoscopic Surgeons (JSLS)* 15:21-26
17. Tien G, **Zheng B**, Atkins MS, (2011) Quantifying surgeon's vigilance during laparoscopic operations using eye-tracking. *Studies in Health Technology and Informatics* 126:658-62
18. Spaun GO, **Zheng B**, Martinec DV, Arnold BN, Swanström LL (2010) A comparison of early learning curves for complex bimanual coordination with open, laparoscopic, and flexible endoscopic instrumentation. *Surgical Endoscopy* 24(9):2145-55.
19. **Zheng B**, Cassera MA, Martinec DV, Spaun GO & Swanström LL (2010) Measuring mental workload during the performance of advanced laparoscopic tasks. *Surgical Endoscopy.* 24(1):45-50.
20. **Zheng B**, Hur HC, Johnson S Swanström LL (2010) Validity of Using Fundamental Laparoscopic Surgery (FLS) Program to Assess Laparoscopic Competence for Gynecologists. *Surgical Endoscopy.* 24(1):152-60
21. **Zheng B**, Swanström LL (2009) Video analysis of anticipatory movements performed by the surgeons during laparoscopic procedures. *Surgical Endoscopy*, 23(7):1494-8

22. Spaun GO, **Zheng B**, Swanström LL (2009) A multitasking platform for NOTES; a bench top comparison of a new device for flexible endoscopic surgery and a standard dual channel endoscope, *Surgical Endoscopy*. 23 (12):2720-7
23. Martinec DV, Gatta P, **Zheng B**, Denk PM, Swanström LL (2009) Tradeoff between flexibility and maneuverability: task performance with articulating laparoscopic instruments. *Surgical Endoscopy*, 23 (12): 2697-2701
24. Cassera MA, **Zheng B**, Martinec DV, Swanström LL (2009). Surgical time independently affected by surgical team size, *The American Journal of Surgery* 198(2):216-22
25. Spaun GO, **Zheng B**, Martinec DV, Cassera MA, Dunst CM, Swanström LL.(2009) Bimanual coordination in NOTES: Comparing conventional dual-channel endoscope, the R-scope and a novel direct drive system. *Gastrointestinal Endoscopy (GIE)*, 69(6):e39-45.
26. **Zheng B**, Taylor MD & Swanström LL (2008) An observation on surgery-related activities between surgeon and nurse during laparoscopic surgery. *The American Journal of Surgery* 197(4):497-502.
27. **Zheng B**, Martinec DV, Cassera MA & Swanström LL (2008) A quantitative study of disruption in the operating room during laparoscopic anti-reflux surgery. *Surgical Endoscopy*. 22(10): 2171-7
28. Chang S, Waid E. **Zheng B**, Matinec DV, & Swanström LL (2008) Impacts of verbal feedback on laparoscopic team performance. *Surgical Innovation*, 15(2):143-7
29. Swanström LL & **Zheng B** (2008) Spatial Orientation and Off-Axis Challenges for NOTES. *Gastrointestinal Endoscopy Clinics of North America*. 18(2):315-24.
30. **Zheng B**, Swanström LL & MacKenzie CL (2008) A laboratory study on anticipatory movement in laparoscopic Surgery: a behavioral indicator for team collaboration. *Surgical Endoscopy* 21:935-40

Conference Proceedings (HQP)

- 1) Tien G, Atkins MS, Jiang X, **Zheng B**, **Bednarik R** (2014) Verbal gaze instruction matches visual gaze guidance in laparoscopic skills training. In *Proceedings of the Eye Tracking Research and Applications (ETRA)*; 2014;.
- 2) Jiang X, Tien G, Atkins MS, **Zheng B** (2014) Pupil dilations during target-pointing respect Fitts' Law. In *Proceedings of the Eye Tracking Research and Applications (ETRA)*; 2014; .
- 3) Gierl MJ., Lai H, Fung K, & **Zheng B**. (2013). Developing and evaluating methods to automatically generate items in multiple languages. Paper presented at the annual meeting of the *National Council on Measurement in Education*, San Francisco, CA. April 2013
- 4) Tien G, Atkins MS, **Zheng B** (2012) Measuring gaze overlap on videos between multiple observers. In *Proceedings of the Eye Tracking Research and Applications (ETRA)*; 2012; 309-312.
- 5) Atkins MS, Jiang X, Tien G, Meneghetti A, **Zheng B** (2012) Saccadic delays on targets while watching videos. In *Proceedings of the Eye Tracking Research and Applications (ETRA)*; 2012; 405-409.
- 6) Tien G, Atkins MS, **Zheng B**, Swindells C (2010) Measuring situation awareness of surgeons in laparoscopic training. In *Proceedings of Eye Tracking Research and Applications*. 2010:149-152.
- 7) **Zheng B** & MacKenzie CL (2009) A comparison of human performance in grasping virtual objects by hand and with tools of different length ratios. In: *The Proceedings of 53rd. Human Factors and Ergonomics Society Annual Meeting* 1156-1160.
- 8) **Zheng B** & MacKenzie CL (2007) Kinematics of reaching and grasping with a tool. In: *The Proceedings of 51st. Human Factors and Ergonomics Society Annual Meeting* 1353-1357.
- 9) **Zheng B** & MacKenzie CL (2007) The control strategy for degrees of freedom in remote prehension with a tool. In: *The Proceedings of 51st. Human Factors and Ergonomics Society Annual Meeting* 1358-1362.

Non-refereed contribution: Invited Presentation

- 1) **Zheng B**, (2013) Visual study in MIS surgery, The Research Weeks at 2nd Hospital of Zhejiang University, Oct 22, 2013, Hangzhou, China
- 2) **Zheng B**, (2013) Simulation training for MIS skills, Grand Round at Sir Run Run Shaw Hospital, Oct 21 2013, Hangzhou, China
- 3) **Zheng B**, (2013) Sim-TRC: Simulation for faculty development, East-West Alliance Conference, Oct 19 2013, Shantou, China
- 4) **Zheng B**, (2013) Five basic elements for constructing simulation-based education program, Beijing MIS Conference, Sept 15, 2013

- 5) **Zheng B**, (2013) 3D vision and its application in surgical training and patient safety. Workshop on Computer in Medicine and Improving Human-Computer Interaction, University of Zhejiang, March 29, 2013
- 6) **Zheng B**, (2013) Measure mental workloads of surgeon. Surgery Grand Round, University of Alberta, Jan 4, 2013
- 7) **Zheng B**, (2012) Surgical Education under Simulated and Virtual Training Environment. Invited Presentation at Canada's GRAND Digital Wave Workshop, Nov 6, 2012
- 8) **Zheng B**, (2012) Simulation in MIS Skills Training. Invited Speech at 4th China MIS Conference, Aug 31, 2012 Chengdu, China
- 9) **Zheng B**, (2012) Simulation in MIS Team Training. Invited Speech at 4th China MIS Conference, Sept 02, 2012 Chengdu, China
- 10) **Zheng B**, (2012) Workload assessment of surgeons: Correlation between NASA TLX and blinks. Oral Presentation at SAGES March 8, 2012
- 11) **Zheng B**, (2012) Surgical team composition and its impact on procedure time. Surgery Grand Round, University of Alberta, Jan 6, 2012
- 12) **Zheng B**, (2011) Quantifying mental workload of surgeons performing NOTES procedure. Presentation at SAGES April 1, 2011
- 13) **Zheng B** (2010) Human Factors in Minimally Invasive Surgery. Invited Oral Presentation at Canadian Medical & Biological Engineering Society 33rd Conference, Jun18, 2010, Vancouver, BC
- 14) **Zheng B** (2010) Simulation for Skills Acquisition in Surgery. Invited Oral Presentation at City-Wide Round, Feb 2, 2010, UBC Surgery
- 15) **Zheng B** (2010) Team Cooperation for Patient Safety in the Operating Theatre. Invited Oral Presentation at City-Wide Round, Jan 20, 2010, UBC Surgery
- 16) **Zheng B** (2009) Learning Process of NOTES Procedure. Invited Presentation at General Surgery Update, Dec 6, 2009, UBC Surgery
- 17) **Zheng B**, Pachev G (2009) Advancing a Research Agenda in Simulation. Invited Oral Presentation at International Conference on Residency Education, Sept 24, 2009, Victoria, BC.
- 18) **Zheng B** (2009) Team Cooperation for Patient Safety in the Operating Theatre. Invited Oral Presentation at Canadian Surgery Forum, Sept 12, 2009, Victoria, BC.
- 19) **Zheng B**, (2009) Measuring mental workload during the performance of advanced laparoscopic tasks. Oral Presentation at SAGES April 24, 2009

Contributions to Practical Applications of Knowledge.

A list of collaborators and their institutions

Outside U of Alberta:

- Dr. Sidney Fels, Professor, Electrical and Computer Engineering, UBC (GRAND-NCE PNI)
- Dr. Roy Eagleson, University of Western Ontario (GRAND-NCE PNI)
- Dr. Garnette Sutherland, Neurosurgery, University of Calgary. Program director of NeuroArm Surgical Robot. 1 CFI grant for surgical robot.
- Dr. Lee Swanström, Director of Minimally Invasive Surgery, Clinical Professor of Oregon Health and Science University, world-leader in minimally invasive surgery. 4 grant awards, 12 publications.
- Dr. Karim Qayumi, Director of Centre of Excellence for Simulation Education and Innovation, University of British Columbia, world leader in surgical simulation. 2 grant awards, 8 publications, co-supervisor for 2 graduate students
- Dr. M. Stella Atkins, Director of Medical Imaging. Computing Science, Simon Fraser University. Pioneer in eye-tracking of surgeons. 1 grant award, 7 publications, co-supervisor for 3 graduate students

Within U of Alberta:

- Dr. Pierre Boulanger, Director of the Advanced Man-Machine Interface Laboratory, Faculty of Engineering, 2 grant application, sharing research facilities
- Dr. Jonathan White, Tom Williams Endowed Chair in Surgical Education, leader in undergraduate surgical education, 2 grant applications

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- Dr. Daniel Birch, Director of Center of Advanced Minimally Invasive Surgery. Leader in minimally invasive surgery and surgical simulation. 1 grants application.
- Dr. Mahdi Tavakoli, Director of the Telerobotic & Biorobotic Systems, Faculty of Engineering, 1 NSERC CHRP project under development.
- Dr. Weimin Mou, Director of the Virtual Reality and Spatial Cognition Lab, Dept. of Psychology

3. Other Evidence of Impact and Contributions

- Awards

<i>Date</i>	<i>Awarding Organization</i>	<i>Type and Value</i>
2013	Digital Alberta Award (combined software and hardware)	
2012	Edmonton Civil Employees Charitable Assistance Fund Award	\$10,000
09/2004	President's Ph.D. Research Stipend SFU	\$6,000
2001- 2003	Michael Smith Foundation for Health Research (MSFHR)	Doctoral Trainee Award (\$22,500 per yr)
05/2002	Institute for Robotics and Intelligent Systems (IRIS)	Best Poster Award (\$500)
09/2001	Graduate Fellowship, Applied Science, SFU	\$5,000

4. Delays in Research Activity: N/A

5. Contributions to the Training of Highly Qualified Personnel (HQP)

Name	Type of Training and status	Years Supervised or Co-supervised	Title of Project or Thesis	Present Position
Consent Received From Individual(s)				
Eric Fung	Master (in progress)	2013-2015	Microsurgical Training and Assessment: Human Factors	3 rd Year Resident, UA
Rositsa Bogdanova	Master (In progress)	Supervised 2013-2015	3D vision in image-guided surgery	
Xiaolin Wang	Post-doc (In Progress)	Supervised 2012-2013	3D model for pre-surgery planning	Pediatric surgeon, China
Xianta Jiang	PhD. (In progress)	Co-Supervised 2010-	Blinks and pupil size as an behavioral indicator for mental stresses of surgeons	
Geoffrey Tien	PhD. CS (In progress)	Co-Supervised 2010-	Towards understanding eye-hand coordination behaviors in MIS surgery	
Rana Khan	M. Surg (In Progress)	Supervised 2010-2012	Analysis of eye gaze between surgeons-in-training and expert during laparoscopic procedures	4 th Year Surgical Resident at UBC
Jean Shenk	M. A.	Co-Supervised 2010-2011	Assessing the experience of trainees undergoing a novel training for surgical skills	Register Nurse at Prince George, BC