



ICPMMT 2020 Keynote Speech

Design and Manufacturing of Knee Implants for Osteoarthritis Patients

DR MAZIAR RAMEZANI

BACKGROUND



Dr Maziar Ramezani is a Senior Lecturer in Department of Mechanical Engineering, Auckland University of Technology (AUT). His research activities can be broadly divided into four main categories: tribology, additive manufacturing, metal forming and composite materials. He is the founder and director of Tribology and Surface Engineering Lab in AUT.

The tribology research group he leads has extensive research collaborations with international partners, and is currently conducting research on different areas of tribology, including defining the wear mechanisms of different composite materials and metals manufactured by powder bed fusion additive manufacturing techniques, knee prosthesis design optimisation to minimise wear, developing new environmentally friendly lubricants for load-bearing applications, tribo-corrosion and fatigue of dental implants, development of coating systems, and manufacturing and testing of a new type of artificial cartilage targeting younger patients with osteoarthritis. He is the author of more than 80 peer-reviewed journal papers and two books. He is currently serving as AUT's Programme Leader for Maritime Engineering.

QUALIFICATIONS

- Ph.D. in Mechanical Engineering, 2010, Universiti Sains Malaysia, Penang, Malaysia
- M.E. in Mechanical Engineering, 2006, University of Semnan, Semnan, Iran
- B.E. in Mechanical Engineering, 2004, Babol Noshirvani University of Technology, Babol, Iran



RELEVANT EMPLOYMENT HISTORY

- August 2012 – Current: Senior Lecturer, Department of Mechanical Engineering, Auckland University of Technology, Auckland, New Zealand.
- October 2011 – August 2012: Research Fellow, Centre for Infrastructure Engineering and Safety (CIES), University of New South Wales, Sydney, Australia.
- March 2010 – October 2011: Senior Lecturer, School of Mechanical Engineering, Univerisiti Sains Malaysia, Penang, Malaysia.

RESEARCH INTERESTS

Tribology, Load-bearing orthopaedic implants, Dental implants, Tribo-corrosion, Friction sliding structural connections, Bio-based lubricants, Coating, Finite Element Analysis, Metal forming, Additive manufacturing, Composite materials, Impact mechanics, Fatigue and Creep.

MAJOR RESEARCH PAPERS (WITHIN 5 YEARS):

1. Arjmandi, M. & **Ramezani, M.** (2019). Finite element modelling of sliding wear in three-dimensional textile hydrogel composites. *Tribology International*, 133, 88-100.
2. Asif, M., **Ramezani, M.**, Khan, K., Khan, M. & Aw, K.C. (2019). Experimental and numerical study on the effect of silica filler on tensile strength of 3D printed particulate nanocomposite. *Comptes rendus Mecanique* DOI:10.1016/j.crme.2019.07.003
3. Saeidi, M., Gubaua, J.E., Kelly, P., Kazemi, M., Besier, T., Oening Dicati, G.W., Pereira, J.T., Neitzert, T. & **Ramezani, M.** (2019). The influence of an extra-articular implant on bone remodelling of the knee joint. *Biomechanics and Modeling in Mechanobiology* DOI: 10.1007/s10237-019-01193-7
4. Asif, M., **Ramezani, M.**, Khan, K., Khan, M. & Aw, K.C. (2019). Investigation of the strain-rate dependent mechanical behaviour of a photopolymer matrix composite with fumed nano-silica filler. *Polymer Engineering & Science* DOI:10.1002/pen.25168
5. Arjmandi, M. & **Ramezani, M.** (2019). Mechanical and tribological assessment of silica nanoparticle-alginate-polyacrylamide nanocomposite hydrogels as a cartilage replacement. *Journal of the Mechanical Behavior of Biomedical Materials*, 95, 196-204.
6. Li, M., Assadian, M., **Ramezani, M.** & Aw K.C. (2019). Printed Soft Angular/Torque Sensors Using Carbon Black-Silicone Composite. *Sensor Review* DOI: 10.1108/SR-11-2018-0290
7. Li, H., **Ramezani, M.**, Chen, Z., Singamneni, S. (2019) Effects of process parameters on temperature and stress distributions during selective laser melting of Ti-6Al-4V. *Transactions of the Indian Institute of Metals* DOI: 10.1007/s12666-019-01785-y



8. Saeidi, M., **Ramezani, M.**, Kelly, P., Neitzert, T. & Kumar, P. (2019). **Preliminary study on a novel minimally invasive extra-articular implant for unicompartmental knee osteoarthritis.** *Medical Engineering and Physics*, 67, 96-101.
9. **Ramezani, M.**, Klima, S., Le Clerc de la Herverie, P., Campo, J., Le Joncour, J.B., Rouquette, C., Scholze, M. & Hammer, N. (2019). In-silico pelvis and sacroiliac joint motion: Refining a model of the human osteoligamentous pelvis for assessing physiological load deformation using an inverted validation approach. *BioMed Research International*, Article ID 3973170.
10. Hammer, N., Höch, A., Klima, S., Le Joncour, J.B., Rouquette, C. & **Ramezani, M.** (2019). Effects of Cutting the Sacrospinous and Sacrotuberous Ligaments. *Clinical Anatomy*, 32(2), 231-237.
11. Khanlari, K., **Ramezani, M.**, Kelly, P., Cao, P. & Neitzert, T. (2019). An investigation on reasons causing inferiority in unlubricated sliding wear performance of 60NiTi as compared to 440C steel. *Tribology Transactions*, 62, 96-109.
12. Arjmandi, M. & **Ramezani, M.** (2019). Effect of silica nanoparticles on wear mechanism of Alginate-Polyacrylamide hydrogel matrix as a load-bearing biomaterial. *Key Engineering Materials*, 823, 15-20.
13. Asif, M., **Ramezani, M.** & Aw, K.C. (2019). Effect of Interfacial Adhesion on Tensile Strength of 3D Printed Particulate Nanocomposites. *IOP Conference Series: Materials Science and Engineering* 520, 012001.
14. Arjmandi, M., **Ramezani, M.**, Bolle, T., Köppe, G., Gries, T. & Neitzert, T. (2018) Mechanical and tribological properties of a novel hydrogel composite reinforced by three-dimensional woven textiles as a functional synthetic cartilage. *Composites Part A: Applied Science and Manufacturing*, 115, 123-133.
15. Scholze, M., Singh, A., Lozano, P.F., Ondruschka, B., **Ramezani, M.**, Werner M. & Hammer, N. (2018) Utilization of 3D printing technology to facilitate and standardize soft tissue testing. *Scientific Reports*, 8:11340.
16. Li, H., **Ramezani, M.**, Li, M., Ma, C. & Wang, J. (2018) *Tribological performance of selective laser melted 316L stainless steel.* *Tribology International*, 128, 121-129.
17. Khanlari, K., **Ramezani, M.**, Kelly, P., Cao, P. & Neitzert, T. (2018). Mechanical and microstructural characteristics of as-sintered and solutionized porous 60NiTi. *Intermetallics*, 100, 32-43.
18. Asif, M., Lee, J.H., Lin-Yip, M.J., Chiang, S., Levaslot, A., Giffney, T., **Ramezani, M.** & Aw, K.C. (2018) A New Photopolymer Extrusion 5-Axis 3D Printer. *Additive Manufacturing*, 23, 355-361.
19. Khanlari, K., **Ramezani, M.**, Kelly, P., Cao, P. & Neitzert, T. (2018). Comparison of the reciprocating sliding wear of 58Ni39Ti-3Hf alloy and baseline 60NiTi. *Wear*, 408-409, 120-130.



20. Arjmandi, M., **Ramezani, M.**, Nand, A. & Neitzert, T. (2018) Experimental study on friction and wear properties of interpenetrating polymer network alginate-polyacrylamide hydrogels for use in minimally-invasive joint implants. *Wear*, 406-407, 194-204.
21. Li, H., **Ramezani, M.**, Li, M., Ma, C. & Wang, J. (2018) Effect of process parameters on tribological performance of 316L stainless steel parts fabricated by selective laser melting. *Manufacturing Letters*, 16, 36-39.
22. Heredia-Cancino, J.A., **Ramezani, M.** & Álvarez-Ramos, M.E. (2018) Effect of degradation on tribological performance of engine lubricants at elevated temperatures. *Tribology International*, 124, 230-237.
23. Giordano, M., Schmid, S., Arjmandi, M. & **Ramezani, M.** (2018). Abrasive wear of polymer fibers investigated by reciprocal scratching in an atomic force microscope. *ASME Journal of Tribology*, 140(2), 021604.
24. Khanlari, K., **Ramezani, M.**, Kelly, Cao, P. & Neitzert, T. (2018). Reciprocating sliding wear behavior of 60NiTi as compared to 440C steel under lubricated and unlubricated conditions. *Tribology Transactions*, DOI:10.1080/10402004.2018.1460434.
25. Heilig, S., **Ramezani, M.**, Neitzert, T. & Liewald, M. (2018). Tribological performance of duplex-annealed Ti-6Al-2Sn-4Zr-2Mo titanium alloy at elevated temperatures under dry sliding condition. *Journal of Materials Engineering and Performance*, 27(4), 2003-2009.
26. Heilig, S., **Ramezani, M.**, Neitzert, T. & Liewald, M. (2018). Investigation of friction and wear properties of duplex-annealed Ti-6Al-2Sn-4Zr-2Mo against hardened AISI E52100 at linear reciprocating motion. *Transactions of the Indian Institute of Metals*, 71(5), 1257-1264.
27. Khanlari, K., **Ramezani, M.**, & Kelly, P. (2018). 60NiTi: A Review of Recent Research Findings, Potential for Structural and Mechanical Applications, and Areas of Continued Investigations. *Transactions of the Indian Institute of Metals*, 71(4), 781-799.
28. Khanlari, K., **Ramezani, M.**, Kelly, Cao, P. & Neitzert, T. (2018). Effect of hafnium-addition in 60NiTi alloy hardened under open atmosphere conditions. *Metallography, Microstructure, and Analysis*, 7, 476-486.
29. Khanlari, K., **Ramezani, M.**, Kelly, Cao, P. & Neitzert, T. (2018). Synthesis of as-sintered 60NiTi parts with a high open porosity level. *Materials Research*, 21(5): e20180088.
30. Khanlari, K., **Ramezani, M.**, Kelly, Cao, P., Hayat, M. & Neitzert, T. (2018). An investigation on microstructural and mechanical properties of porous 60NiTi parts solutionized by different cost-effective methods. *Metallography, Microstructure, and Analysis*, 7(3), 334-346.
31. Arjmandi, M., **Ramezani, M.**, Nand, A. & Neitzert, T. (2018) Tribological characterization of polyacrylamide-alginate hybrid hydrogels as a potential candidate for cartilage replacement. *Key Engineering Materials*, 775, 109-114.



32. Saeidi, M., **Ramezani, M.**, Kelly, P., Hussin, M.S. & Neitzert, T. (2018). Biomechanics of a novel extra-articular implant for younger patients with knee osteoarthritis. *Current Directions in Biomedical Engineering*, 4(1), 203-205.
33. Zhu, Y., Assadian, M., **Ramezani, M.** & Aw K.C. (2018). Printing of soft stretchable sensor from carbon black composites. *MDPI Proceedings*, 2, 732; doi:10.3390/proceedings2130732.
34. Khanlari, K., **Ramezani, M.**, Kelly, Hayat, M., Cao, P. & Neitzert, T. (2018). Effects of open atmosphere solutionizing treatment on the microstructural and mechanical properties of porous 60NiTi parts. *Key Engineering Materials*, 770, 87-94.
35. Arjmandi, M., **Ramezani, M.**, Giordano, M. & Schmid, S. (2017). Finite element modelling of sliding wear in three-dimensional woven textiles. *Tribology International*, 115, 452-460.
36. Giordano, M., Schmid, S., Arjmandi, M. & **Ramezani, M.** (2017). Wear evaluation of three-dimensionally woven materials for use in a novel cartilage replacement. *Wear*, 386-387, 179-187.
37. **Ramezani, M.** (2017). Influence of heat treatment techniques on hot formability of AZ61 magnesium alloy. *AIP Conference Proceedings*, 1846, 040003; doi: 10.1063/1.4983605.
38. **Ramezani, M.**, Flores-Johnson, E., Shen, L. & Neitzert, T. (2017). High strain rate compressive behaviour of selective laser melted Ti-6Al-4V. *Materials Science Forum*, 890, 323-326.
39. **Pereira, M.**, **Ramezani, M.**, Pasang, T. & Withy, B. (2017). Investigation of polyurethane bonding to steel in sandwich panels. *Materials Science Forum*, 890, 401-405.
40. Khanlari, K., **Ramezani, M.**, Hayat, M., Kelly, P., Cao, P. & Neitzert, T. (2017). Microstructural and mechanical properties of porous 60NiTi prepared by conventional press-and-sinter method. *MATEC Web of Conferences*, 109, 01002; doi: 10.1051/mateconf/201710901002.
41. **Ramezani, M.** & Neitzert, T. (2016). Computer simulations of direct extrusion of sintered Ti-6Al-4V alloy at elevated temperature. *International Journal of Applied Engineering Research*, 11(6), 3848-3852.
42. Pasang, T., **Ramezani, M.**, Prygoski, M., Wanhill, R., Byrnes, R., Kamiya, O., Tanaka, K. (2016) Fatigue of commercially pure titanium dental implant. *Materials Physics and Mechanics*, 27, 79-89.
43. **Ramezani, M.** & Schmid, S.R. (2015). Bio-based lubricants for forming of magnesium. *Journal of Manufacturing Processes*, 19, 112-117.
44. **Ramezani, M.** & Neitzert, T. (2015). Investigation of hot formability of AZ61 Mg alloy. *Modern Mechanical Engineering*, 5, 21-27.
45. Tat, D., Pasang, T. & **Ramezani, M.** (2015). Gas tungsten arc welding of copper and mild steel. *International Journal of Science and Engineering Investigations*, 4(45), 32-38.



46. Wang, S., Nates, R., Pasang, T. & **Ramezani, M.** (2015). Modelling of gas tungsten arc welding pool under Marangoni convection. *Universal Journal of Mechanical Engineering*, 3(5), 185-201.
47. Heinzl, H., **Ramezani, M.** & Neitzert, T. (2015). Experimental investigation of the formability of organic coated steel sheet metal. *Procedia Manufacturing*, 1, 854–865.
48. **Ramezani, M.**, Neitzert, T., Pasang, T. & Selles, M.A. (2015). Dry sliding frictional characteristics of ZE10 and AZ80 magnesium strips under plastic deformation. *Tribology International*, 82, 255-262.
49. **Ramezani, M.**, Pasang, T., Chen, Z., Neitzert, T. & Au, D. (2015). Evaluation of carbon diffusion in heat treatment of H13 tool steel under different atmospheric conditions. *Journal of Materials Research and Technology*, 4(2), 114-125.