

Philippe Malcolm

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H-index: 21, 2100 citations

<https://scholar.google.be/citations?user=Q1XcsrUAAAAJ&hl=en&oi=sra>

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Positions

- 2017-present Assistant Professor at the Department of Biomechanics and Center for Research in Human Movement Variability at the University of Nebraska at Omaha, Biomechanics Research Building
- Associated with Harvard University
John A. Paulson School of Engineering and Applied Sciences
and Wyss Institute for Biologically Inspired Engineering
- Postdoctoral collaborator with Movement Science Lab at Ghent University
Department of Movement and Sports Sciences
- 2015-2016 Postdoctoral Research Fellow, Harvard University
John A. Paulson School of Engineering and Applied Sciences
and Wyss Institute for Biologically Inspired Engineering
Role: Biomechanics team-lead in a project on design and development of a soft lower-extremity assistive device
Advisor: Walsh C. J.
- Summer 2013 Visiting Scholar, Carnegie Mellon University
Department of Mechanical Engineering
Project: The influence of push-off timing in a robotic ankle-foot prosthesis on the energetics and mechanics of walking
Advisor: Collins S. H.
- 2010-2014 Postdoctoral Assistant, Ghent University
Department of Movement and Sports Sciences
Laboratory of Movement Science
Advisor: De Clercq D.

Education

- 2004-2010 Ph.D., Ghent University
Thesis: Influence of intrinsic and extrinsic determinants on the transition from walking to running.
Advisor: De Clercq D., Committee: Seyfarth A., Van Leemputte M., Vanrenterghem J., D'Aout K., Witvrouw E., Derave W.
- 2002-2003 Second M.Sc., Academic Teaching Training, Ghent University
- 2000-2002 M.Sc. in Physical Education (Kinesiology), Ghent University,
- 1998-2000 B.Sc. in Physical Education (Kinesiology), Ghent University,

Teaching

- 2021- Present Lab methods in biomechanics II
- 2017- Present Undergraduate biomechanics
- 2017-2019 MATLAB for Movement Sciences
- 2017-2019 Guest lectures for Motor Control I
- 2013-2014 Honors program in movement science, 1st and 2nd year of kinesiology M.Sc.: advanced internship to prepare students for a job as sports scientist or the start of a Ph.D.
- 2012-2013 Lecturer in individual movement activities 1st and 2nd year of kinesiology M.Sc.: coordination of sports and sports didactics courses from 5 teaching assistants on track and field, artistic gymnastics, and swimming.
- 2008-2011 Movement analysis of fitness training, 1st year of kinesiology M.Sc.: EMG and isokinetic measurement practicum
- 2004-2014 Sport-specific movement analysis, 1st year of kinesiology M.Sc.: demonstration of all measurement methods in sports biomechanics and hands-on projects of each student in his sports-coaching specialization
- 2004-2014 Movement analysis, 3rd year of kinesiology B.Sc.: practical exercises on gait analysis and lifting ergonomics with treadmill, force plate, video, and motion capture
- 2004-2014 Biomechanics, 2nd year of kinesiology B.Sc.: practical exercises on ground reaction force measurement and data analysis in Excel

Mentoring and Advising

Present MSc. advisor of Kayla Kowalczyk and Siena Senatore

2020-present PhD. advisor of Alex Dzewaltowski

2021-2022 MSc. advisor of K. Kowalczyk

2021-2022 MSc. advisor of S. Senatore

2018-present PhD. advisor of Gonabadi A. M.

2017-2020 Ph.D. advisor of Prokopios Antonellis

2017-2018 MSc. advisor of Cory Frederick

2015 Co-mentor of one design-engineering final project at Harvard University

2010-2015 Co-advisor Ph.D. Breine B.: Initial foot contact patterns in shod running, relationship with speed and impact intensity

2010-2015 Mentor Ph.D.: Galle S.: Ankle-foot exoskeletons, from experimental optimization to practical applications

2011-2015 Advisor of eight M.Sc. theses in kinesiology and one M.Sc. thesis in electromechanical engineering

2013-2015 Mentor of two honors theses

2004-2010 Mentor of seven M.Sc. theses in kinesiology

Student grant support

2022	CEHHS Outstanding graduate student	Kowalczyk. K.	
2022	RMASB best MSc. presentation finalist	Kowalczyk K.	
2020	HMVC Promising young student finalist	Gonabadi A.	
2020	UNO GRACA	Kowalczyk. K.	\$5000
2020	UNO GRACA	Senatore S.	\$5000
2020	Outstanding graduate student award	Gonabadi. A.	
2019	UNO GRACA	Gonabadi. A.	\$5000
2018	NCSSR workshop Forum Participation Award	Gonabadi. A.	
2018	NCSSR OpenSim virtual workshop	Gonabadi. A.	
2019	AMTI travel grant	Antonellis A.	\$1000
2019	NIH Summer course	Antonellis A.	
2019	Paul Beck Scholarship	Antonellis A.	\$500
2019	UNO GRACA	Antonellis A.	\$5000
2019	UNO FUSE	Runyan T.	\$1000
2018	UNO GRACA	Antonellis A.	\$5000

Publications

Manuscripts as first author (* is equal contribution)

1. **Malcolm, P.**, Galle, S., Van Den Berghe, P., De Clercq, D., 2018. Exoskeleton assistance symmetry matters: Unilateral assistance reduces metabolic cost, but relatively less than bilateral assistance. *J. Neuroeng. Rehabil.* 15. <https://doi.org/10.1186/s12984-018-0381-z>
2. **Malcolm, P.**, Galle, S., Derave, W., de Clercq, D., 2018. Bi-articular knee-ankle-foot exoskeleton produces higher metabolic cost reduction than a weight-matched mono-articular exoskeleton. *Front. Neurosci.* 12.
3. **Malcolm, P.**, Rossi, D. M., Siviyy, C., Lee, S., Quinlivan, B. T., Grimmer, M., and Walsh, C. J. "Continuous Sweep versus Discrete Step Protocols for Studying Effects of Wearable Robot Assistance Magnitude" *Journal of NeuroEngineering and Rehabilitation* 14, no. 1 (2017): 72. doi:10.1186/s12984-017-0278-2
4. **Malcolm, P.**, Lee, S., Crea, S., Siviyy, C., Saucedo, F., Galiana, I., Panizzolo, F. A., Holt, K. G., and Walsh, C. J. "Varying Negative Work Assistance at the Ankle with a Soft Exosuit during Loaded Walking" *Journal of NeuroEngineering and Rehabilitation* 14, no. 1 (2017): 62. doi:10.1186/s12984-017-0267-5
5. **Malcolm, P.**, Galle, S., and Clercq, D. De. "Fast Exoskeleton Optimization" *Science* 356, no. 6344 (2017): 1230–1231. doi:10.1126/science.aan5367 **IF 37**
6. Galle, S., **Malcolm, P.***, Collins, S. H., and Clercq, D. De. "Reducing the Metabolic Cost of Walking with an Ankle Exoskeleton: Interaction between Actuation Timing and Power" *Journal of NeuroEngineering and Rehabilitation* 14, no. 1 (2017): 35. doi:10.1186/s12984-017-0235-0
7. **Malcolm, P.**, Quesada, R. E., Caputo, J. M., and Collins, S. H. "The Influence of Push-off Timing in a Robotic Ankle-Foot Prosthesis on the Energetics and Mechanics of Walking" *Journal of NeuroEngineering and Rehabilitation* 12, no. 1 (2015): 21. doi:10.1186/s12984-015-0014-8
8. **Malcolm, P.**, Breine, B., Frederick, E., Cheung, J., and Clercq, D. De. "Correlations between Strike Index and 5,000 and 10,000 M Performance in Male Runners" *Footwear Science* 5, no. S1 (2013): doi:10.1080/19424280.2013.799581
9. **Malcolm, P.**, Derave, W., Galle, S., and Clercq, D. De. "A Simple Exoskeleton That Assists Plantarflexion Can Reduce the Metabolic Cost of Human Walking" *PLoS One* 8, no. 2 (2013): e56137. doi:10.1371/journal.pone.0056137, **>350 citations.**
10. **Malcolm, P.**, Segers, V., Caekenberghe, I. Van, and Clercq, D. De. "Experimental Study of the Influence of the M. Tibialis Anterior on the Walk-to-Run Transition by Means of a Powered Ankle-Foot Exoskeleton." *Gait & Posture* 29, no. 1 (2009): 6–10. doi:10.1016/j.gaitpost.2008.05.016
11. **Malcolm, P.**, Fiers, P., Segers, V., Caekenberghe, I. Van, Lenoir, M., and Clercq, D. De. "Experimental Study on the Role of the Ankle Push off in the Walk-to-Run Transition by Means of a Powered Ankle-Foot-Exoskeleton" *Gait & Posture* 30, no. 3 (2009): 322–327. doi:10.1016/j.gaitpost.2009.06.002
12. *De Smet, K., ***Malcolm, P.**, Lenoir, M., Segers, V., De Clercq, D., "Effects of Optic Flow on Spontaneous Overground Walk-to-Run Transition" *Experimental brain research* 193, no. 4 (2009): 501–8. doi:10.1007/s00221-008-1648-6

Manuscripts as co-author

1. Antonellis, P., Mohammadzadeh Gonabadi, A., Myers, S. A., Pipinos, I. I., & **Malcolm, P.** (2022). Metabolically efficient walking assistance using optimized timed forces at the waist. *Science Robotics*, 7(64), eabh1925.
2. Takashi, S., Nielsen, J., Takahashi, K., **Malcolm, P.**, Mukherjee, M. (2022). A passive exoskeleton can assist split-belt adaptation. *Experimental Brain Research*, 240(4), 1159–1176.
3. Mohammadzadeh Gonabadi, A., Antonellis, P., **Malcolm, P.** (2021). Differentiating fallers from non-fallers using nonlinear variability analyses of data from a low-cost portable footswitch device: a feasibility study. *Acta of Bioengineering and Biomechanics*.
4. A Mohammadzadeh Gonabadi, P Antonellis, **P Malcolm**, Differences between joint-space and musculoskeletal estimations of metabolic rate time profiles, *PLoS computational biology* 16 (10), e1008280
5. Papachatzis N, **Malcolm P**, Nelson CA, Takahashi KZ. Walking with added mass magnifies salient features of human foot energetics. *Journal of Experimental Biology*. 2020 15;223(12).
6. Gonabadi AM, Antonellis P, **Malcolm P**. A system for simple robotic walking assistance with linear impulses at the center of mass. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 2020.
7. Antonellis P, Frederick CM, Gonabadi AM, **Malcolm P**. Modular footwear that partially offsets downhill or uphill grades minimizes the metabolic cost of human walking. *Royal Society open science*. 2020 Feb 5;7(2):191527.
8. Hedrick, E.A., **Malcolm, P.**, Wilken, J.M. and Takahashi, K.Z., 2019. How Prosthetic Ankle Stiffness & Load Carriage Affect Metabolic Energy Expenditure During Walking. *JNER*, 2019
9. Jinsoo Kim, Giuk Lee, Roman Heimgartner, Dheepak Arumukhom Revi, Nikos Karavas, Danielle Louise Ryan Nathanson, Ignacio Galiana, Asa Eckert-Erdheim, Patrick Murphy, David Perry, Nicolas Menard, **Malcolm P**, Conor J. Walsh; Reducing the metabolic rate of walking and running with a versatile, portable soft exosuit. **Science**, 2019.
10. B Breine, **P Malcolm**, S Galle, P Fiers, EC Frederick, D De Clercq, Running speed-induced changes in foot contact pattern influence impact loading rate, *European journal of sport science* 19 (6), 774-783 2019
11. M Grimmer, BT Quinlivan, S Lee, **P Malcolm**, DM Rossi, C Siviyy, CJ Walsh, Comparison of the human-exosuit interaction using ankle moment and ankle positive power inspired walking assistance, *Journal of biomechanics* 83, 76-84 2 2019
12. P Antonellis, S Galle, D De Clercq, **P Malcolm**, Altering gait variability with an ankle exoskeleton *PloS one* 13 (10), e0205088 2018.
13. Kim, M., Ding, Y., **Malcolm, P.**, Speeckaert, J., Siviyy, C. J., Walsh, C. J., and Kuindersma, S. “Human-in-the-Loop Bayesian Optimization of Wearable Device Parameters” *PLoS ONE* 12, no. 9 (2017): doi:10.1371/journal.pone.0184054
14. Lee, G., Kim, J., Panizzolo, F. A., Zhou, Y. M., Baker, L. M., Galiana, I., **Malcolm, P.**, and Walsh, C. J. “Reducing the Metabolic Cost of Running with a Tethered Soft Exosuit” *Sci. Robot* 2, no. 6 (2017): 6708–31. doi:10.1126/scirobotics.aan6708
15. Quinlivan, B. T., Lee, S., **Malcolm, P.**, Rossi, D. M., Grimmer, M., Siviyy, C., Karavas, N., Wagner, D., Asbeck, A., Galiana, I., and Walsh, C. J. “Assistance Magnitude versus Metabolic Cost Reductions for a Tethered Multiarticular Soft Exosuit” *Science Robotics* 2, no. 2 (2017): eaah4416. doi:10.1126/scirobotics.aah4416 + **150 citations**
16. Breine, B., **Malcolm, P.**, Segers, V., Gerlo, J., Derie, R., Pataky, T., Frederick, E. C., and Clercq, D. De. “Magnitude and Spatial Distribution of Impact Intensity Under the Foot Relates to Initial Foot Contact Pattern” *J Appl Biomech* (2017): 1–21. doi:10.1123/jab.2016-0206
17. Galle, S., Derave, W., Bossuyt, F., Calders, P., **Malcolm, P.**, and Clercq, D. De. “Exoskeleton Plantarflexion Assistance for Elderly” *Gait and Posture* 52, no. November (2017): 183–188. doi:10.1016/j.gaitpost.2016.11.040
18. Breine, B., **Malcolm, P.**, Caekenberghe, I. Van, Caekenberghe, I. Van, Fiers, P., Frederick, E. C., Clercq, D. De, Frederick, E. C., and Clercq, D. De. “Initial Foot Contact and Related Kinematics Affect Impact Loading Rate in Running” *Journal of Sports Sciences* 35, no. 15 (2017): 1556–1564. doi:10.1080/02640414.2016.1225970

19. Ding, Y., Panizzolo, F. A., Sivi, C. J., **Malcolm, P.**, Galiana, I., Holt, K. G., and Walsh, C. J. "Effect of Timing of Hip Extension Assistance during Loaded Walking with a Soft Exosuit" *Journal of NeuroEngineering and Rehabilitation* 13, no. 1 (2016): 87. doi:10.1186/s12984-016-0196-8
20. Lee, S., Crea, S., Galiana, I., Malcolm, P., Walsh, C. J., Galiana, I., Asbeck, A., Walsh, C. J., **Malcolm, P.**, Walsh, C. J., Galiana, I., Asbeck, A., and Walsh, C. J. "Controlling Negative and Positive Power at the Ankle with a Soft Exosuit" *Proceedings - IEEE International Conference on Robotics and Automation 2016–June, (2016)*: 3509–3515. doi:10.1109/ICRA.2016.7487531
21. Breine, B., **Malcolm, P.**, Caekenberghe, I. Van, Fiers, P., and Clercq, D. De. "Kinematic Differences between (A)typical Initial Rearfoot and Midfoot Contact Patterns" *Footwear Science* 7, no. S1 (2015): S102-103.
22. Galle, S., **Malcolm, P.**, Derave, W., and Clercq, D. De. "Uphill Walking with a Simple Exoskeleton: Plantarflexion Assistance Leads to Proximal Adaptations" *Gait and Posture* 41, no. 1 (2015): 246–251. doi:10.1016/j.gaitpost.2014.10.015
23. Galle, S., **Malcolm, P.**, Derave, W., and Clercq, D. De. "Enhancing Performance during Inclined Loaded Walking with a Powered Ankle–foot Exoskeleton" *European Journal of Applied Physiology* 114, no. 11 (2014): 2341–51. doi:10.1007/s00421-014-2955-1
24. Breine, B., **Malcolm, P.**, Frederick, E. C., and Clercq, D. De. "Relationship between Running Speed and Initial Foot Contact Patterns" *Medicine and Science in Sports and Exercise* 46, no. 8 (2014): 1595–603. doi:10.1249/MSS.0000000000000267
25. Caekenberghe, I. Van, **Malcolm, P.**, Segers, V., and Clercq, D. De. "A Gradual Shift in Initial Foot-to-Ground Contact Patterns Depending upon Acceleration" *Footwear Science* 5, no. S1 (2013): S88-89.
26. Galle, S., **Malcolm, P.**, Derave, W., and Clercq, D. De. "Adaptation to Walking with an Exoskeleton That Assists Ankle Extension" *Gait & Posture* 38, no. 3 (2013): 495–499. doi:10.1016/j.gaitpost.2013.01.029

Awards

- 2018 Finalist selection for Clinical Translational Research Superstar grant writing competition.
- October 2013 Study of the week, literature update on mailing list sponsored by the International Society of Biomechanics
Study: Adaptation to walking with an exoskeleton that assists ankle extension.
- April 2013 Study of the week, literature update on mailing list sponsored by the International Society of Biomechanics
Study: A simple exoskeleton that assists plantarflexion can reduce the metabolic cost of human walking.
- 2007 Young Investigator Award, International Society of Biomechanics, XXIth Congress, Taipei
Study: A pneumatic ankle-foot-orthosis as a means to experimentally validate hypotheses about the role of the tibialis anterior in the walk-to-run transition.

Invited Presentations

- 2020 Wearable Robotic Conference “A robotic tether can assist more efficiently than a passive tether, but the optimal timing is counterintuitive.” Virtual WeRob Madrid
- 2019 Using wearable robots to “feel” metabolic cost and provide simple timed assistance. UNMC Surgery Forum. Omaha
- 2019 Using wearable robots to “feel” metabolic cost and provide simple timed assistance. UNO Biomechanics Seminar Series, Omaha.
- 2019 Assistive mechanisms of (distal) ankle exoskeletons and a (proximal) robotic waist tether. ASB symposium on exoskeletons and prostheses.
- 2017 Exoskeleton actuation inspired by and informing biomechanics, BRB Seminar series, Omaha
- 2017 Optimization of exoskeleton actuation: Comparison of results with exoskeletons and exosuits, AHFE, Los Angeles
- 2014 Optimization of a simple Assistive Exoskeleton through human biomechanics experiments, Biodesign lab meeting, Harvard University, Cambridge
- 2014 Optimization of actuation and configuration of assistive devices for walking through human experiments, 7th World Congress of Biomechanics, Boston
- 2013 Effect of actuation and configuration of assistive devices, Lab visit, University of Michigan, Ann Arbor.
- 2013 Bipedal locomotion seminar, Carnegie Mellon University, Pittsburgh
- 2013 A simple exoskeleton can reduce the metabolic cost of walking. Dynamic Walking Conference, Carnegie Mellon University, Pittsburgh
Video: www.youtube.com/watch?v=qXlfHBH4ry0#t=8656
- 2013 A simple pneumatically powered exoskeleton can reduce the metabolic cost of walking, High Tech Systems, Eindhoven

Grants

Current

- 2022 NSF
Detecting the Walking Phases with Raised Oxygen Costs for Targeted Therapy
Role: PI \$238,743
- 2021 NU Collaboration Initiative
Detecting the Walking Phases with Raised Oxygen Costs for Targeted Therapy
Role: PI \$38,399
- 2019 NIH COBRE
Exoskeleton optimization for reducing gait variability in patients with peripheral artery disease.
Role: subproject lead \$548,621 for subproject
- 2020 VA
Exoskeleton footwear to improve walking performance and subject-reported preference.
Role: Co-investigator \$12,051 for own contribution

Completed

- 2018 Nebraska/NSF EPSCOR
Dynamic Indirect Calorimetry.
Role: PI \$50,000
- 2018 University of Nebraska System Collaboration Initiative
Exoskeletons for mobility assistance.
Role: PI \$8,500
- 2017 Industry consultancy grant: J Brasch Co. LLC
Gait-o-gram: differentiating fallers from non-fallers using nonlinear analysis.
Role: PI \$64,480
- 2017 NASA Nebraska
Influence of foot-ground traction on gaits for reduced gravity.
Role: PI \$24,092.

University Committee Service

- 2022 - present Academic Standards and Policies, 2022 - Present
- 2021 - present UNMC adult IRB, 2021 - Present
- 2019-2020 Assistant professor search committee, 2019 - 2020
- 2017-2019 Committee Member, Students activity committee, 2017 - 2019
- 2017-2018 Committee Member, Associate Professor search committee, 2017 - 2018

Conference service

- 2021 Co-organizer Rocky Mountain American Society of Biomechanics
- 2019 Session co-chair at American Society of Biomechanics
- 2018, 2019 Session chair at Rocky Mountain American Society of Biomechanics

Referee service

Performed 78 manuscript reviews for:
Biocybernetics and Biomedical Engineering, European Journal of Applied Physiology, Frontiers in Neuroscience, Gait & Posture, IEEE International Conference on Intelligent Robots and Systems, IEEE International Conference on Rehabilitation Robotics, IEEE International Conference on Robotics and Automation, IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics, IEEE Robotics and Automation Letters, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Journal of Applied Physiology, Journal of Biomechanics, Journal of Mechanical Design - Transactions of the ASME, Journal of NeuroEngineering and Rehabilitation, Journal of the Royal Society Interface, Plos One, Robotica, Royal Society Open Science, Science Robotics, Scientific Reports
Review service record available on <https://publons.com/researcher/1217881/philippe-malcolm>

2017-present Performed grant reviews for Canadian and European funding agencies

Media

Covered by over 150 news outlets, including:
AAAS Newsletter, BBC, Boston Globe, EOS, Exoskeleton Report, Gizmodo, IEEE Soft Robotics podcast (scheduled for June), New Scientist, NPR Science Friday, Popular Mechanics, Reddit, Scientific American, The Economist, The Telegraph

Source www.altmetric.com

Memberships

International Society of Biomechanics
American Society of Biomechanics
American Association for the Advancement of Science
Wearable Robotics Association
Institute of Electrical and Electronics Engineers (IEEE)

Outreach

2020	Nebraska Robotics expo
2019	National biomechanics day and Nebraska Robotics expo
2018	National biomechanics day and Nebraska Robotics expo
2017	Reddit AMA on Exoskeletons
2015	Family Day of Discovery, Harvard University: Soft Exosuit demonstration
2014	Kids university day, Ghent University: Lecture about biomechanical support of an elite high jump athlete
2009	Science night, Ghent University: Biomechanical support of an elite high jump athlete
2004-2014	Ghent University: Yearly open-lab days for high-school students