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Research Interest

- My PhD research focused on the experimental investigation of the mutual interaction between *hydrokinetic turbines* and the surrounding physical environment. This technology converts water currents (i.e. tides, rivers and ocean currents) into renewable energy, in the same fashion as wind turbines harness wind. Rivers in particular represent ubiquitous and continuous sources of kinetic energy. This study led me into the intricate world of river morphodynamics. Specifically, I investigated how finite discontinuity or inhomogeneity in the spanwise flow velocity distribution (like those induced by hydrokinetic turbines or any other disturbance) can trigger river instabilities also known as *forced bars*, deemed to be the onset of channel meandering.

As a Postdoctoral Research Associate at Oak Ridge National Laboratory (ORNL) I worked on both conventional hydropower and hydrokinetic energy. I am particularly interested in exploring how water power production can be made more sustainable while continuously pursuing its technological advancement.

I am currently continuing my main postdoc research as a R&D Staff Member in the Water Resource Science and Engineering Group at Oak Ridge National Laboratory.

Current Position

- August 2021 ... → R&D Associate Staff Member, Water Resource Science and Engineering, Oak Ridge National Laboratory.

Education

- June 2019 → **PhD** in Civil, Environmental and Geo- Engineering, University of Minnesota - Twin Cities, USA. **Minor** in Aerospace Engineering and Mechanics (AEM). GPA: 3.96.
Dissertation: “ Local and Non-local Geomorphic Effects of Hydrokinetic Turbines: Bridging Renewable Energy and River Morphodynamics. ” (adv. Dr. Michele Guala).
- Jul. 2013 → **MS** in Environmental Engineering, Department of Civil, Environmental and Mechanical Engineering, University of Trento, Italy.
Dissertation: “ Experimental investigation on the interaction between MHK turbines and an erodible river bed. ” (adv. Dr. Michele Guala, Dr. Marco Toffolon and Dr. Annunziato Siviglia).
- Nov. 2010 → **BS** in Environmental Engineering, Department of Civil, Environmental and Mechanical Engineering, University of Trento, Italy.
Dissertation: “ Biogas production from waste and livestock sludge ” (in Italian) (adv. Prof. Flavio Deflorian).

Publications and Presentations

Publications

- Hanna, R., Dugoua, E., Nuñez-Jimenez, A., Nock, D., Arcusa, S., Castellanos, S., Davidson, M.R., Edwards, M.R., Galeazzi, C., Gao, X., Graff, M., Kennedy, K.M., Kontou, E., Lathwal, P., **Musa, M.**, O’Rear, E., Sivaranjani, S., Zhang, J., Zhu, W (2022). “Net zero needs investment in people too”, *Science*, **378(6625)**, 1181-1181.
- Hansen, C., **Musa, M.**, Sasthav, C., and DeNeale, S. (2021). “Hydropower development potential at non-powered dams: Data needs and research gaps”, *Renewable and Sustainable Energy Reviews*, 145, doi:10.1016/j.rser.2021.111058.
- Redolfi, M., **Musa, M.**, and Guala, M. (2021). “On steady alternate bars forced by a localized asymmetric drag distribution in erodible channels”, *Journal of Fluid Mechanics*, 916, doi:10.1017/jfm.2021.122
- Lee, J., **Musa, M.**, and Guala, M. (2021). “Scale-dependent bedform migration and deformation in the physical and spectral domains”, *Journal of Geophysical Research - Earth Surface*, <https://doi.org/10.1029/2020JF005811>.
- Guala, M., Heisel, M., Singh, A., **Musa, M.**, Buscombe, D., and Grams, P. (2020). “A mixed length scale model for migrating fluvial bedforms”, *Geophysical Research Letters*, 47, <https://doi.org/10.1029/2019GL086625>.
- **Musa, M.**, Ravanelli, G, Bertoldi, W., and Guala, M. (2020). “Hydrokinetic turbines in yawed conditions: towards synergistic fluvial installations”, *Journal of Hydraulic Engineering*, **146(4)**, 1–12.
- Lee, J., **Musa, M.**, Feist, C., Gao, J., Shen, L., and Guala, M. (2019), “Wake Characteristics and Power Performance of a Drag-Driven in-Bank Vertical Axis Hydrokinetic Turbine”, *Energies*, **12(19)**, 3611.
- Gotelli, C., **Musa, M.**, Guala, M., and Escauriaza, C. (2019), “Experimental and Numerical Investigation of Wake Interactions of Marine Hydrokinetic Turbines”, *Energies*, **12(16)**, 3188.
- **Musa, M.**, Hill, C., and Guala, M. (2019), “Interaction between hydrokinetic turbine wakes and sediment dynamics: array performance and geomorphic effects under different siting strategies and sediment transport conditions”, *Renewable Energy*, **138**, 738-753
- **Musa, M.**, Hill, C., Sotiropoulos, F., and Guala, M. (2018), “Performance and resilience of hydrokinetic turbine arrays under large migrating fluvial bedforms”, *Nature Energy* **3**, 839–846. [[Journal Cover](#)].
- **Musa, M.**, Heisel, M., and Guala, M. (2018), “Predictive model for local scour downstream of hydrokinetic turbines in erodible channels”, *Physical Review Fluids* **3**, 024606.
- Hill, C., **Musa, M.**, and Guala, M. (2016), “Interaction between instream axial-flow hydrokinetic turbines and river bedforms”, *Renewable Energy*, **86**, 409–421.
- Hill, C., **Musa, M.**, Chamorro, L.P., Ellis, C., and Guala, M. (2014). “Hydrokinetic turbine operating in an erodible channel”, *Journal of Hydraulic Engineering* **140**, [[PDF Article](#)].

Pending Publications

- Tseng, C., **Musa, M.**, DeNeale, S., and Stewart, K., “Hydraulic and Power Implications of Hydrokinetic Energy Application within Hydropower Tailraces”, In preparation for *Renewable Energy*.

Publications and Presentations (continued)

Technical Reports

- **Musa, M.**, Ghobrial, L., Sasthav, C., Heineman, J., Rencheck, M., Stewart, K., DeNeale, S., Tseng, C., White, D., Davis, L., Kelsey, R., Nachman, M., (2023). "Advanced Manufacturing and Materials for Hydropower: Challenges and Opportunities". No. *ORNL/TM-2023/2835*, Oak Ridge National Lab (ORNL), Oak Ridge, TN (United States), doi: 10.2172/1960692.
- **Musa, M.**, Smith, B., Sasthav, C., DeSomber, K., DeNeale, S., Stewart, K., Marsh, M., Smith, T., and Irminger, P., (2022). "Needs and Opportunities for Testing of Hydropower Technology Innovations". No. *ORNL/TM-2022/2462*, Oak Ridge National Lab (ORNL), Oak Ridge, TN (United States), doi:10.2172/1892413.
- Deneale, S., Sasthav, C., **Musa, M.**, Hansen, C., Stewart, K. and Matson P., (2022). "Non-Powered Dam Retrofit Exemplary Design for Hydropower Applications". No. *ORNL/TM-2021/2232*, Oak Ridge National Lab (ORNL), Oak Ridge, TN (United States), doi:10.2172/1869108.
- Hansen, C., Sasthav, C., **Musa, M.**, and Deneale, S., (2022). "Non-Powered Dam Custom Analysis and Taxonomy (NPDamCAT) Framework". No. *ORNL/TM-2021/2155*, Oak Ridge National Lab (ORNL), Oak Ridge, TN (United States), doi:10.2172/1855679.
- DeNeale, S., Bishop, N., Buetikofer, L., Sisson, R., Sasthav, C., **Musa, M.**, Wilcox, T., Stewart, K., Tingen, W., and DeRolph, C., (2020). "Hydropower Geotechnical Foundations: Current Practice and Innovation Opportunities for Low-Head Applications". No. *ORNL/TM-2021/1553*, Oak Ridge National Lab (ORNL), Oak Ridge, TN (United States), doi:10.2172/1649157.

Presentations, Organized Sessions, and Workshops

- 2023
 - **Invited Speaker.** Advanced Manufacturing and Materials for Hydropower: Challenges and Opportunities. *Hydropower Materials Research Workshop*. Electric Power Research Institute (EPRI). August 7-8 (virtual).
- 2022
 - Tseng, C. and **Musa, M.**, Siting Optimization of In-stream Hydrokinetic Turbines within Hydropower Tailrace Channels. *American Physical Society - Division of Fluid Dynamics*, Indianapolis, IN, November 20-22.
 - **Musa, M.** and Tseng, C., Expanding Hydropower Generation Using Hydrokinetic Turbines in Tailrace Channels: A Feasibility and Site Optimization Study. *American Geophysical Union - Fall Meeting 2022*, Chicago, IN, December 12-16.
 - **Organizer and facilitator.** Advanced Manufacturing for Hydropower Workshop. August 3-4, Oak Ridge National Laboratory, Manufacturing Demonstration Facility.
 - **Invited Participant.** 2022 Climate-Tech Policy "Boot Camp" for Early Career Researchers. <https://itif.org/events/2022/06/05/2022-climate-tech-policy-boot-camp-for-early-career-researchers/>. June 5-10, Washington DC.
 - **Co-Organizer.** Monitoring and Modeling the Effects of Aquatic Barriers on River Ecosystems (session). *Joint Aquatic Sciences Meeting*, May 14–20, Grand Rapids, MI.
- 2021
 - **Organizer and primary convener.** Monitoring the Effects of Human Management of Hydrological Systems: From in Situ Observations to Remote Sensing and Modeling (session). *American Geophysical Union - Fall Meeting*, December 13–17, New Orleans, LA.
- 2020
 - **Musa, M.**, and DeNeale, S., "Potential hydraulic and power effects of hydrokinetic turbines deployed within hydropower tailrace channels.". *American Geophysical Union - Fall Meeting*, virtual, December 2020.

Presentations, Organized Sessions, and Workshops (continued)

- 2018
- **Musa, M.**, and Guala, M., "Experimental evidence of river morphodynamic instabilities forced by finite asymmetric flow perturbations". *American Geophysical Union - Fall Meeting*, Washington D.C., December 2018.
 - **Musa, M.**, Hill, C., Sotiropoulos, F., and Guala, M., "Hydrokinetic energy harvesting in large natural rivers: a multifaceted experimental study". *American Physical Society - Division of Fluid Dynamics Meeting*, Atlanta, GA, November 2018.
 - **Musa, M.**, Heisel, M., Hill, C., and Guala, M., "Local and Non-local geomorphic effects of Marine Hydrokinetic Turbines: from a single turbine to a power plant array". *5th IAHR Europe Congress*, Trento, Italy, June 2018.
- 2017
- **Musa, M.**, Hill, C., Heisel, M., and Guala, M., "Analytical model for local scour prediction around hydrokinetic turbine foundations". *American Geophysical Union - Fall Meeting*, New Orleans, LA, December 2017.
 - **Musa, M.**, Hill, C., Heisel, M., and Guala, M., "Experimental investigation of axial-flow turbine arrays in sandy channels". *2017 Waterpower week in Washington - Marine Energy Technology Symposium*, Washington D.C., April 2017.
- 2016
- **Musa, M.**, Hill, C., and Guala, M., "Advancing marine hydrokinetic turbine arrays towards large-scale deployments in sandy rivers: a laboratory study". *American Physical Society - Division of Fluid Dynamics Meeting*, Portland, OR, November 2016.
 - **Musa, M.**, Hill, C., and Guala, M., "MHK impact on erodible channel bathymetry: from single turbine to a power plant array". *Hydrovision International 2016*, Minneapolis, MN, July 2016.
- 2015
- **Musa, M.**, Hill, C., and Guala, M., "Local and non-local effects of spanwise finite perturbations in erodible river bathymetries". *American Physical Society - Division of Fluid Dynamics Meeting*, Boston, MA, November 2015.

Honors and Awards

- 2020
- *Best Dissertation Award* in Physical Sciences and Engineering of the University of Minnesota Graduate School.
- 2018
- *Doctoral Dissertation Fellowship* Recipient 2018-2019 Academic Year (graduate tuition and stipend), University of Minnesota.
 - *American Physical Society - Division of Fluid Dynamics* Travel Grant for the APS - DFD conference in November 2018.
- 2017
- *CEGE Travel Grant* Recipient 2017-2018 Academic Year, Civil, Environmental & Geo-Engineering Department, University of Minnesota.
 - *Heinz Stefan Fellowship* Recipient 2016-2017 Academic Year, St. Anthony Falls Laboratory, University of Minnesota.
 - *Student Council Travel Award* Recipient 2016-2017 Academic Year, St. Anthony Falls Laboratory, University of Minnesota.
- 2016
- *Tsai Travel Award* Recipient 2016-2017 Academic Year, St. Anthony Falls Laboratory, University of Minnesota.
- 2014
- *CEGE Department Fellowships* Recipient 2014-2015 Academic Year, Department of Civil, Environmental & Geo-Engineering Department, University of Minnesota.

Editorial Activities

Reviewer for Peer-Reviewed journals

- Nature Energy, (Nature)
- Renewable Energy, (Elsevier)
- Energy, (Elsevier)
- Ocean Engineering, (Elsevier)
- Journal of Renewable and Sustainable Energy (American Institute of Physics)
- Sustainable Energy Technologies and Assessments, (Elsevier)
- Journal of Ecohydraulics, (Taylor & Francis)
- International Journal of Sediment Research, (Elsevier)
- Energies, (MDPI)
- Water, (MDPI)

Teaching

Undergraduate courses

- Fall 2018 → **Renewable Energies.** Teaching Assistant and lecturer on *Conventional Hydropower systems.*

Mentor Activities

Postdoctorals (Primary Advisor)

- 2022 - present → Chien-Yung Tseng, Oak Ridge National Laboratory.

Graduate Students (Not Primary Advisor)

- 2019 - 2022 → Jiyong Lee, University of Minnesota (now at Utrecht University). Primary advisor: Michele Guala.

Master Students (Not Primary Advisor)

- 2018 → Giulia Ravanelli, University of Trento. Primary advisors: Walter Bertoldi (University of Trento) and Michele Guala (University of Minnesota). Thesis: *Experimental investigation on the interaction between a river turbine and an erodible channel in yawed conditions.*
- Clemente Gotelli, Pontificia Universidad Católica de Chile. Primary advisors: Cristián Escauriaza (Pontificia Universidad Católica de Chile) and Michele Guala (University of Minnesota). Thesis: *Experimental and Numerical Investigation of Wake Interactions of Marine Hydrokinetic Turbines.*

Community and Professional Service

- 2021 → *ORNL Engineers Week*, volunteer at virtual meeting with the 8th grade class at Midway Middle School in Roane County (TN).
- 2018 → *Minnesota State Fair*, volunteer for the College of Science and Engineering booth.
- *SASSA (Science and Social Studies Adventures)*, volunteer at Maple Grove Middle School (MN). Presentation and hands-on demonstration on fluvial transport and erosion.

Community and Professional Service (continued)

- 2016 → *Sip of Science (NCED)* invited presentation, **Musa, M.**, and Guala, M., (2016). “A different type of hydropower: the rise of Marine Hydrokinetic energy, Sip of Science (NCED), Minneapolis, MN, February 2016.

Memberships & Affiliations

- 2023-2024 → Affiliate with the Center for Energy, Transportation, and Environmental Policy at the Baker School for Public Policy and Public Affairs of the University of Tennessee.
- 2017 - present → Member of the American Geophysical Union, (AGU)
- 2014 - present → Member of the American Physics Society, (APS)

Leadership Experience

- 2017 - 2019 → Member of the Graduate Student Board for the CEGE Department as representative of the Water Resources program. My duties involved meeting with the Director of Graduate Studies, discuss the well being of the graduate students, evaluate and solve potential student-related conflicts in the department and help organizing the departmental welcome week for new applicants.
- 2015 - 2019 → Member of the Saint Anthony Falls Lab (SAFL) Student Council. My position included: management of the student fund, organization of social events for the students at SAFL and maintenance of the bikes used by SAFL students during their commute to campus.

Working Experience

- September 2019 -
July 2021 → Postdoctoral Research Associate in Water Resource Science and Engineering Group at Oak Ridge National Laboratory.
- April 2014 -
July 2014 → Consultant Engineer at Gruppo Finservice in Mantova (Italy). My task was assisting our clients (mostly private companies, public institutions and municipalities) during the preparation of proposals for European funding grants (7th Framework Programme) .
- Sept. 2013 -
Nov. 2013 → Research assistant at the Department of Civil, Environmental and Mechanical Engineering, University of Trento, under the supervision of Dr. Walter Bertoldi. My tasks involved the analysis of experimental data and mathematical modeling of sediment transport processes in braided rivers.

Languages

- *Italian*: native speaker.
- *English*: fluent.
- *Spanish*: beginner.