frontiers | Frontiers in Energy Research

TYPE Editorial
PUBLISHED 22 October 2025
DOI 10.3389/fenrg.2025.1724395

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Uwe Schröder,
University of Greifswald, Germany

*CORRESPONDENCE
David Howe Wood,
dhwood@ucalgary.ca

RECEIVED 13 October 2025
ACCEPTED 15 October 2025
PUBLISHED 22 October 2025

CITATION
Wood DH (2025) Editorial: Co-operative progress in distributed wind and hydrokinetic energy systems.
Front. Energy Res. 13:1724395.
doi: 10.3389/fenrg.2025.1724395

Editorial: Co-operative progress in distributed wind and hydrokinetic energy systems

David Howe Wood*

University of Calgary, Calgary, Canada

KEYWORDS

wind turbines, hydrokinetic turbines, vertical axis turbines, airfoils, resource assessment

Editorial on the Research Topic
Co-operative progress in distributed wind and hydrokinetic energy systems

Fluid machines whose axis of rotation is parallel to the water or air flow dominate many areas of technology. In approximate historical order, we have the modern emergence of ship (e.g., Carlton, 2019) and then aircraft propellers (Anderson, 2024), wind turbines (Spera, 2009), and finally hydrokinetic turbines (Ibrahim et al., 2021), that extract the kinetic energy of a water stream rather than available head or potential energy of a water body. The blades of these machines have airfoil or hydrofoil cross-sections, which generate a torque about the axis of rotation and thereby extract energy from the fluid. In other words, their operating principles are similar notwithstanding differences such as the possibility of cavitation in hydromachines.

Despite this commonality, wind turbine researchers, for example, are often ignorant of modern work in hydrokinetic turbines. This means the different technologies develop to some extent independently of each other and may well display something like convergent evolution of species that are physically separated. Would not progress be faster if there were greater interaction between these researchers in the different technologies? To attempt to answer that question in the affirmative is the purpose of this Research topic.

The first paper in this topic, "Calculation of the velocities induced by the trailing vorticity in the rotor plane of a horizontal-axis turbine or propeller" by Wood concerns the effect of having a finite number of blades on a turbine or propeller. The fundamental techniques for doing this were developed by Kawada (1936) for aircraft propellers and further critical work was done in the context of ship propellers by Wrench (1957). Wind turbines researchers, on the other hand, have continued to rely on Prandtl's "tip loss factor" which is simple but limited to the ideal case of straight, radial blades with no loading at the tip. The challenge is to develop techniques for induced velocity calculation that handle more complex cases including blade sweep (curvature in the plane of rotation), coning (curvature out of the plane of rotation), ducted rotors, and unequal blade loads, that are not accurately represented by Prandtl's ingenuous method. These complex cases arise in both wind and water machines.

As mentioned above, all technologies under consideration rely on airfoil and hydrofoil sections for the blades. Thus, any effort to improve foil performance is likely to be of general benefit. The second paper by Zheng and Chen "Aerodynamic Performance and Wake Development of NACA 0018 Airfoil with Serrated Gurney Flaps" uses sophisticated computational fluid dynamics to investigate the effects of a serrated "Gurney flap" on airfoil performance. This flap is a small vertical extension of the foil from the bottom of the trailing edge, which is easily added to a complex blade shape, unlike many proposed modifications to foil geometries. Zheng found significant improvements in the lift:drag ratio which is a common measure of foil efficiency.

Liu's paper "Wind power short-term prediction based on digital twin technology" addresses the important issue of resource prediction for energy extraction. Both the wind and water environments are turbulent and the flow direction can change. A range of modern methodologies has been developed for resource prediction and assessment as a way of dealing with the intermittency. Liu's contribution is to use the recent idea of a "digital twin" to improve a neural network prediction of future wind speeds.

Nealy all large wind turbines have a horizontal-axis, but many vertical-axis turbines have been proposed for smaller-scale application for wind and water flows. The paper by Alqahtani "Optimization of VAWT Installation with Spatial and Temporal Complexities Considerations" examines the wind resource available around highways for small vertical-axis wind turbines (VAWTs). Better understanding of the resource should lead to improved machine design for energy efficiency.

The last paper is by Wood and Golmirzaee "On the outer boundary conditions for the fluid dynamics simulation of vertical-axis turbines". The numerical modelling of vertical-axis wind and hydroturbines often use boundary conditions that effectively constrain the flow in the direction normal to the freestream, leading to an over-estimation of power output, especially if the turbines are close together. Improved boundary conditions were suggested and a simple, approximate correction proposed. It has long been argued that placing wind and hydrokinetic turbines in close proximity will increase the power output but this claim needs to be carefully assessed with reference to the boundary conditions.

Where would increased co-operation lead? In practical terms, the development of hydrokinetic turbines could benefit from the lessons learned in designing, building, and testing small wind turbines for "distributed" wind energy, see for example, the description of the research program (NREL, 2025). Will we see floating offshore wind turbines each combined with a hydrokinetic turbine? Increased research co-operation could lead to improved low-Reynolds number foils for wind and marine applications, improved sustainability of blade manufacture, more effective control systems for rapidly varying wind and water speeds, and many others.

Author contributions

DW: Writing – review and editing, Writing – original draft.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

References

Anderson, J. D. (2024). *Fundamentals of aerodynamics*. 7th edn. McGraw-Hill.

Carlton, J. S. (2019). *Marine propellers and propulsion*. 4th edn. Elsevier Butterworth Heinemann.

Ibrahim, W. I., Mohamed, M. R., Ismail, R. M. T. R., Leung, P. K., Xing, W. W., and Shah, A. A. (2021). Hydrokinetic energy harnessing technologies: a review. *Energy Rep.* 7, 2021–2042. doi:10.1016/j.egyr.2021.04.003

Kawada, S. A. N. D. I. (1936). Induced velocity by helical vortices. *J. Aeronautical Sci.* 3 (3), 86–87. doi:10.2514/8.141

NREL (2025). Distributed wind aeroelastic modeling. New York: Wind Research Publications. Available online at: https://www.nrel.gov/wind/distributed-wind-aeroelastic-modeling.

Spera, D. A. (2009). *Wind turbine technology*. 2nd edn. ASME Digital Editions.

Wrench, J. (1957). *The calculation of propeller induction factors*. Alexandria, Virginia: David Taylor Model Basin, 1116. Tech. Rep.