

# Reference flow speeds in tidal turbine experiments

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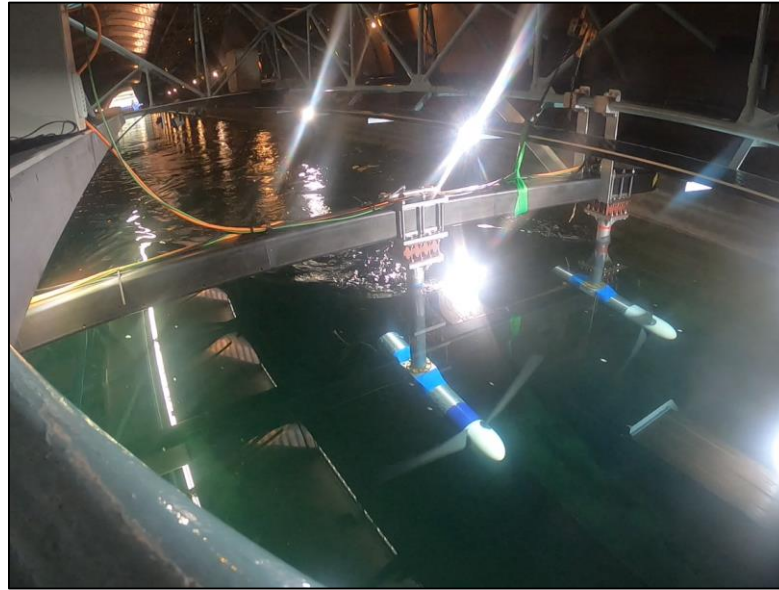
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# Constructive interference (1+1>2?)



Single / twin turbines  
FloWave, UK, February 2019

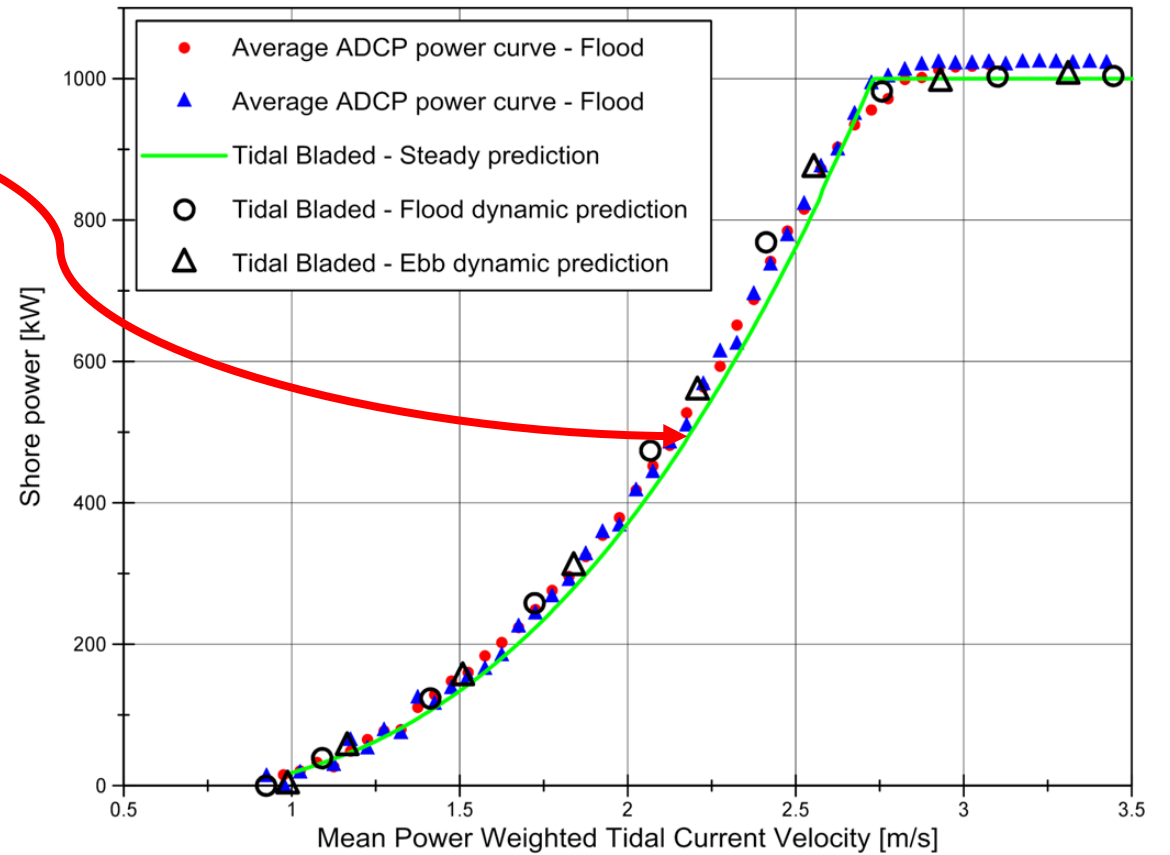
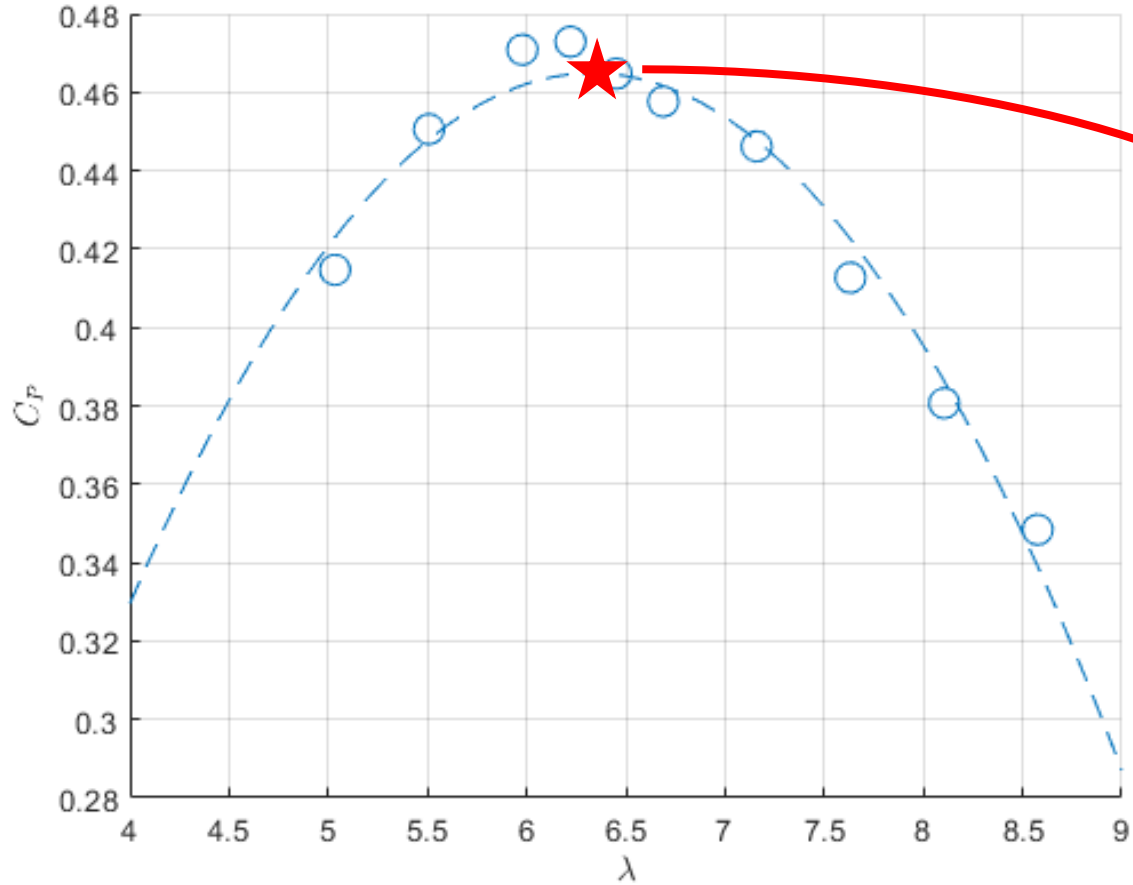


4-turbine fence  
SSPA, Sweden, September 2019



Dynamic loading in waves  
QinetiQ, UK, July 2021

# Reference flow speed

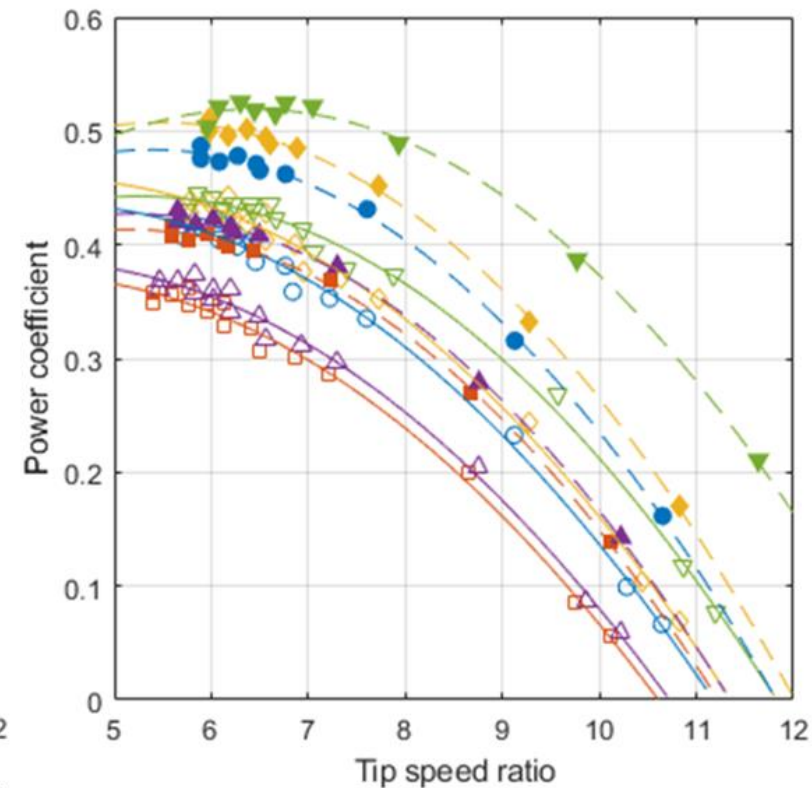
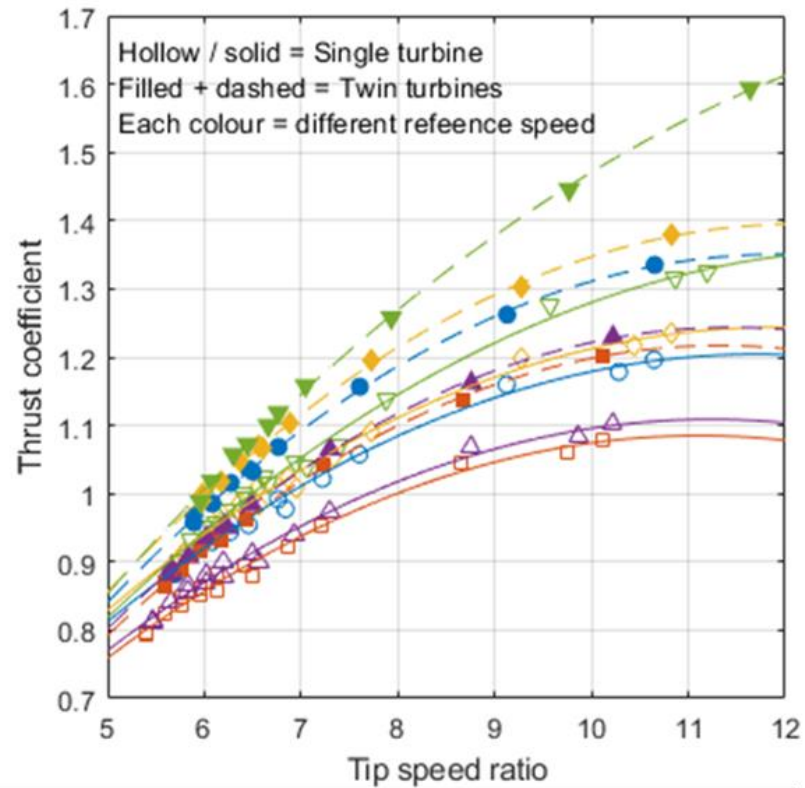
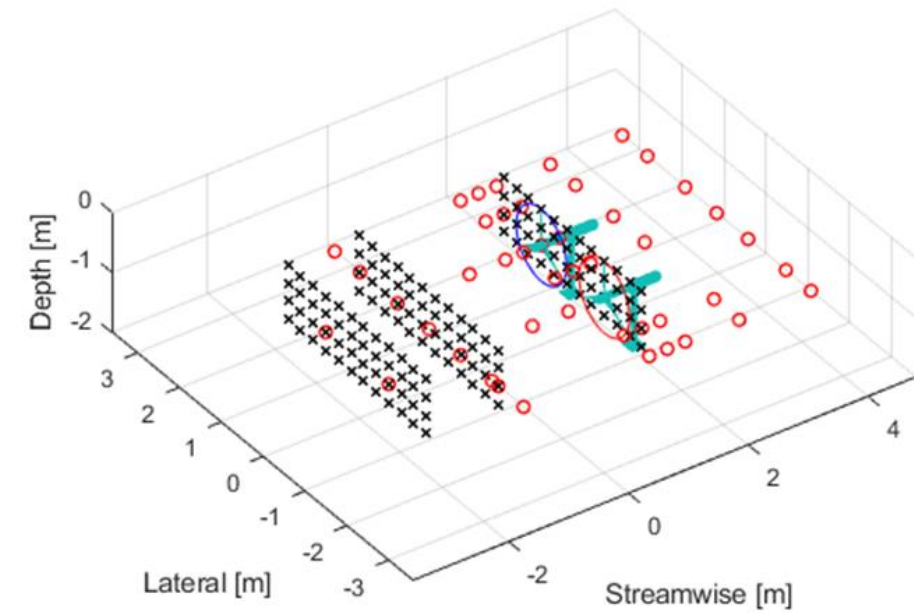


McNaughton et al. [1]

# (A few) choices of reference speed

Reference	Instrument	Facility	Sampling area	Location	Turbines present
McNaughton et al. [2]	Vectrino	FloWave	Rotor area	3D upstream	No
McNaughton et al. [3]	Carriage speed	SSPA			
Allmark et al. [4]	LDV	Ifremer	Single point	1.11D upstream	Yes
Bahaj et al. [5]	Pitot static tube		Single point	N/A	N/A
Payne et al. [6]	LDV	Ifremer	Single point	Rotor plane	No
Porter et al. [7]	LDV	Ifremer	Single point	4.35D upstream	Yes
Kolekar et al. [8]	Not reported	Lehigh University			
Ebdon et al. [9]	LDV	Ifremer	Single point	Rotor plane	No
Martinez et al. [10]	ADV	Ifremer	Vertical profile	Rotor plane	No
	ADV*	CNR-INM	Vertical profile	Rotor plane	No
	ADV	FloWave	Rotor area	Rotor plane	No

# Effect of reference speed (FloWave data)



# Summary

- Reference flow speed affects reported results
  - (e.g. performance gains from constructive interference)
- Inconsistent approaches in the literature
  - Not a problem but rarely justification or uncertainty analysis for choices
- Guidelines for lab testing do not specify position nor approach
- We (ECRs) need to perform rigorous experiments and develop robust procedures
- Contact me to discuss – [mcnaughton712@gmail.com](mailto:mcnaughton712@gmail.com)

# References

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