UNIVERSITY of WASHINGTON HARRIS HYDRAULICS LABORATORY

ALICE C. TYLER FLUME

TYLER FLUME@UW

The Alice C. Tyler flume is a free-surface water channel with independent control of flow speed, water depth, and water temperature.

The flexible controls of the Tyler flume allow the Reynolds and Froude numbers to be independently varied during turbine experiments. Turbulence intensity is relatively low (1-3%). The flume side walls and bottom are glass, providing optical access for flow diagnostics, including Laser Doppler Velocimetry (LDV) and Particle Image Velocimetry (PIV). Using existing instrumentation and data acquisition, cross-flow turbine rotors and axial-flow turbine blades can be easily tested.





FACILITY DESCRIPTION

- > Open channel flume
- > Dimensions: 4.6 m long, 0.76 m wide, 0.7 m high
- > Open top, optical-quality glass side walls and base
- > Dynamic depth: 30 60 cm
- > Temperature: 10 35° C
- > Velocity: Up to 1.1 m/s (depends on dynamic depth and temperature)

> Turbulence intensity: 1-3% (depends on operating conditions)

FACILITY INSTRUMENTATION

Nortek Vectrino Profilers (ADV)

- o 2x with cabled and fixed heads
- Maximum sampling rate of 200 Hz

• Nortek Vector (ADV)

o Maximum sampling rate of 64 Hz

• Particle Image Velocimetry (PIV)

- Planar velocity measurement (x,y velocity) with automated z-axis motion
- 2x Vision Research Phantom v641
 high-speed cameras, 2560x1600
 pixels, 10-1450 fps at full resolution
- Dual-cavity Terra PIV laser, 527 nm wavelength, 0.1-10 kHz pulse repetition
- TSI post-processing software
- Available in 2020/2021: Stereo velocity measurement (x,y,z velocity), LaVision post-processing
- Available in 2020/2021: Laser Doppler Velocimetry (x,y,z velocity)

• Positioning gantry

• Mounted on top of flume test section – can be used to profile ADVs in x, y, and z directions

• Cross-flow turbine test rig - rotor characterization

- 6-axis load cells on both ends of vertically oriented rotor (ATI Mini45 and ATI Mini40)
- o Servomotor for torque, velocity or position control
- o Force, torque and rotation data acquisition at 1 kHz
- Recommended test article size < 17 cm diameter and < 25 cm height (blockage < 10%)

• Axial-flow turbine test rig - blade characterization

- o 6-axis load cells at blade root and in nacelle
- o Variable pitch actuation
- \circ Force, torque and rotation data acquisition at 100 Hz
- o Up to 45-cm blade span

AREAS OF EXPERTISE

- Cross-flow and axial-flow turbine performance and load characterization
- Experimental design to independently vary Reynolds number, Froude number and flow confinement
- Flow-field quantification in and around cross-flow turbine rotors

More Info: www.pmec.us/testing/harris-hydraulics-lab Contact: testing@pmec.us

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Cross-flow turbine rotors can be easily integrated with load cells.



An axial-flow turbine test rig allows for detailed blade characterization tests.



Post-processed flow fields for in-rotor PIV of a cross-flow turbine.

ACKNOWLEDGEMENT



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