Draft Notes from Test of Faceted VAWT Aug 28 2019
Drew Rokeby-Thomas
drewrokebythomas@gmail.com

Run 1 out on 10ohm and back on 4 ohm

Run 2 out on 10 ohm reset 10 ohm to be about 70%-80% on return

Notes,

Data was collected from 4 analog and 1 digital input to a Vernier Labquest data logging and pass through device. The sensors were a wind speed sensor (speed), a load cell measuring torque from the turbine via a 0.2m load arm (force), a voltmeter(Pot) and ammeter(Current)(both Pot and Current were connected to the heating load (post rectifier) and a photo gate reading a 36 tooth per revolution fence. Data is collected 72 times per revolution of the turbine, with the collection being triggered by the photo gate change.

r this testing I observed no wind, clear calm day in a mountain valley about 540m above sea level and 25 deg.

Notes about calculated readings- CP, TSR,
The Cp ratings here may be distorted by both imperfect location of the Wind Speed sensor, and the uncalibrated torque sensor. The Cp readings distort naturally as the test vehicle slows down and the turbine inertia dumps into the alternator, at the same time as the Wind Speed sensor shows lower wind speeds. Reliable readings require stability in TSR, Wind Speed, and Torque for the longest period of turbine rotations available. Results must not be cherry picked from distorted readings.

The TSR readings could be affected by the Wind Speed sensor.

Issues with the current configuration of the tests system include

1. The wind sensor is directional, and so crosswinds or tailwinds could affect measurements. This will be resolved by changing it's mount so that it can rotate to face the wind, and adding a "tail" so that it self aligns with the wind.

2. The load cell is not calibrated.

3. The turbine and alternator are mounted around a 1" diameter aluminum non rotating vertical shaft., with the magnet array's attached to the turbine and being rotated by it, around the shaft. This shaft is mounted in a separate set bearings as well, so that it could rotate, and to prevent that a load arm is clamped to the shaft, which keeps the aluminium shaft from rotating by being connected to a load cell, which is connected to the test frame. At about 70% of the turbine height, the aluminum shaft ends, well above the rotating 3D printed rotating mast/ frame. I fixed a 3D printed plastic sleeve to the inside of the turbine shell, and it acts as a bearing for the top of the shaft, and supports the aerodynamic loads on the turbine. It is not a ball bearing, just a PLA printed sleeve, and I plan to improve it, as I believe it's likely creating a lot of friction drag, especially at the higher speeds, and will be wearing out quickly. It may be one factor in the apparent low efficiency of the alternator.

4. Stator mount is a 3D printed part, coated in epoxy and some fibreglass. It should be reinforced, it may be subject to large loads at high rotations speeds, if the load is suddenly changed by shorting the alternator or something to that effect, it may break and the stator may rotate with the turbine.

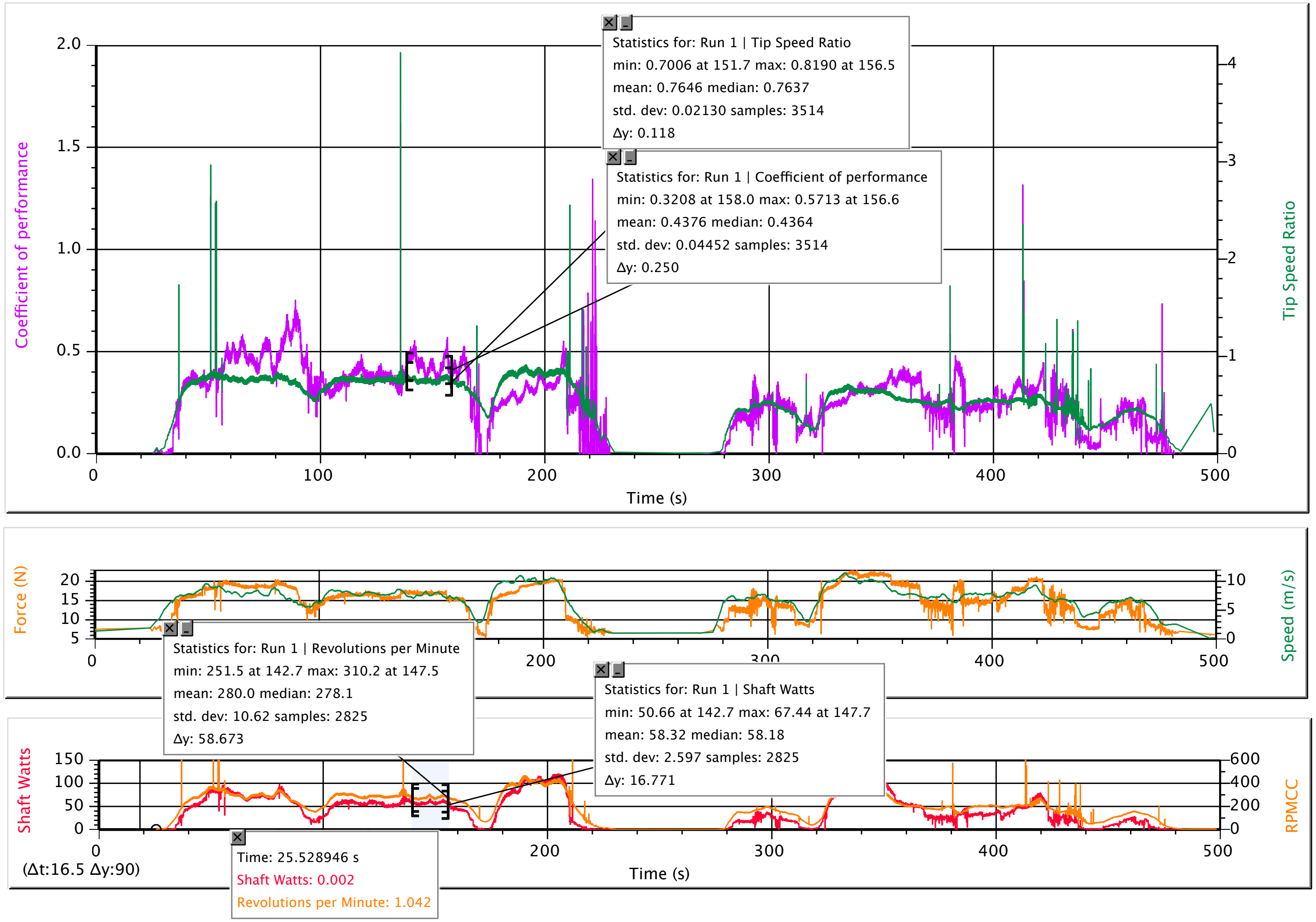
	Velocity (m/s)	RPMCC	RPSCC	SWCC
1				
2				
3	0.022	1.042	0.109	0.002
4				
5	0.191	9.167	0.960	0.183
6				
7	0.177	8.491	0.889	0.100
8				
9	0.080	3.825	0.400	0.081
10				
11	0.099	4.748	0.497	0.113
12				
13	0.117	5.625	0.589	0.134
14				
15	0.147	7.049	0.738	0.167
16				
17	0.169	8.102	0.848	0.192
18				
19	0.183	8.762	0.917	0.236
20				
21	0.198	9.482	0.993	0.285
22				
23	0.209	10.040	1.051	0.137
24				
25	0.221	10.594	1.109	0.058
26				
27	0.233	11.162	1.169	0.011
28				

Potential 1
-0.16 V

Force 6.21 N

Current
-0.007 A

Speed
1.1 m/s



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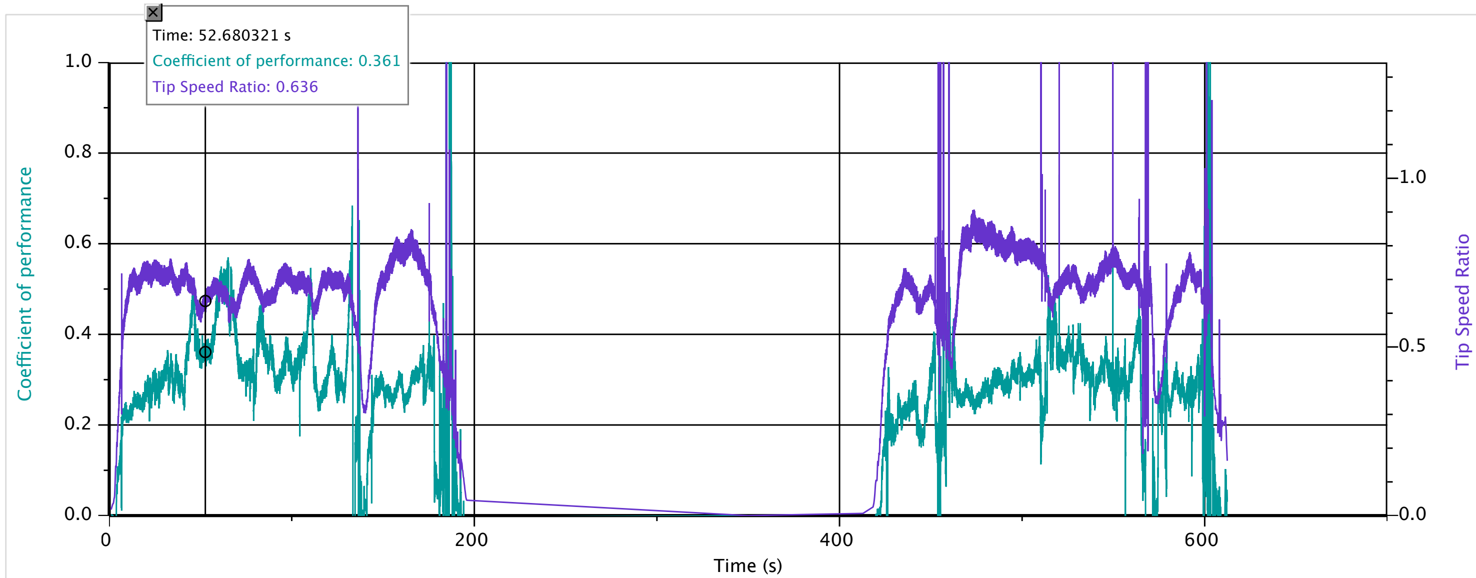
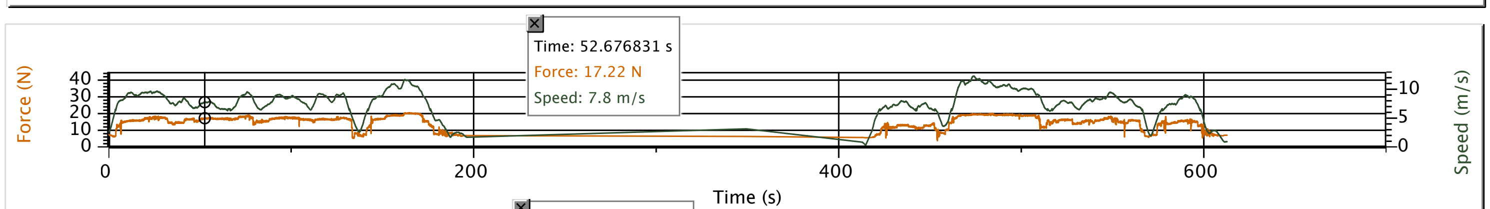
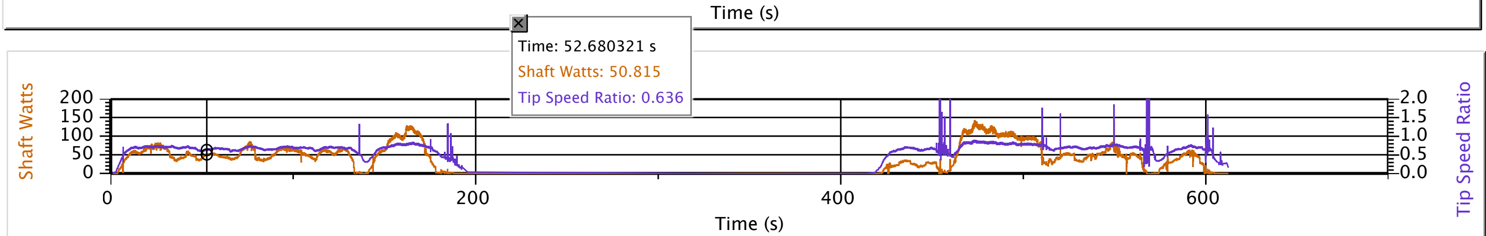
	Run 2			
	SWCC	GW	TSRCC	WW C
16223	51.196	9.764	0.651	140.7
16224		9.764		140.7
16225	51.324	9.764	0.652	140.7
16226		9.764		140.7
16227	50.943	9.764	0.647	140.7
16228		9.764		140.7
16229	50.692	9.764	0.644	140.7
16230		9.764		140.7
16231	50.835	9.764	0.646	140.7
16232		9.764		140.7
16233	48.601	10.025	0.649	139.4
16234		10.025		139.4
16235	48.046	10.025	0.641	139.4
16236		10.025		139.4
16237	47.812	10.025	0.638	139.4
16238		10.025		139.4
16239	47.991	10.025	0.641	139.4
16240		10.025		139.4
16241	47.938	10.025	0.640	139.4
16242		10.025		139.4
16243	47.911	10.025	0.640	139.4
16244		10.025		139.4
16245	50.885	9.902	0.637	140.7
16246		9.902		140.7
16247	50.804	9.902	0.636	140.7
16248		9.902		140.7
16249	50.815	9.902	0.636	140.7







Potential 1	Force 6.21 N
-0.16 V	

Current	Speed
-0.007 A	1.1 m/s

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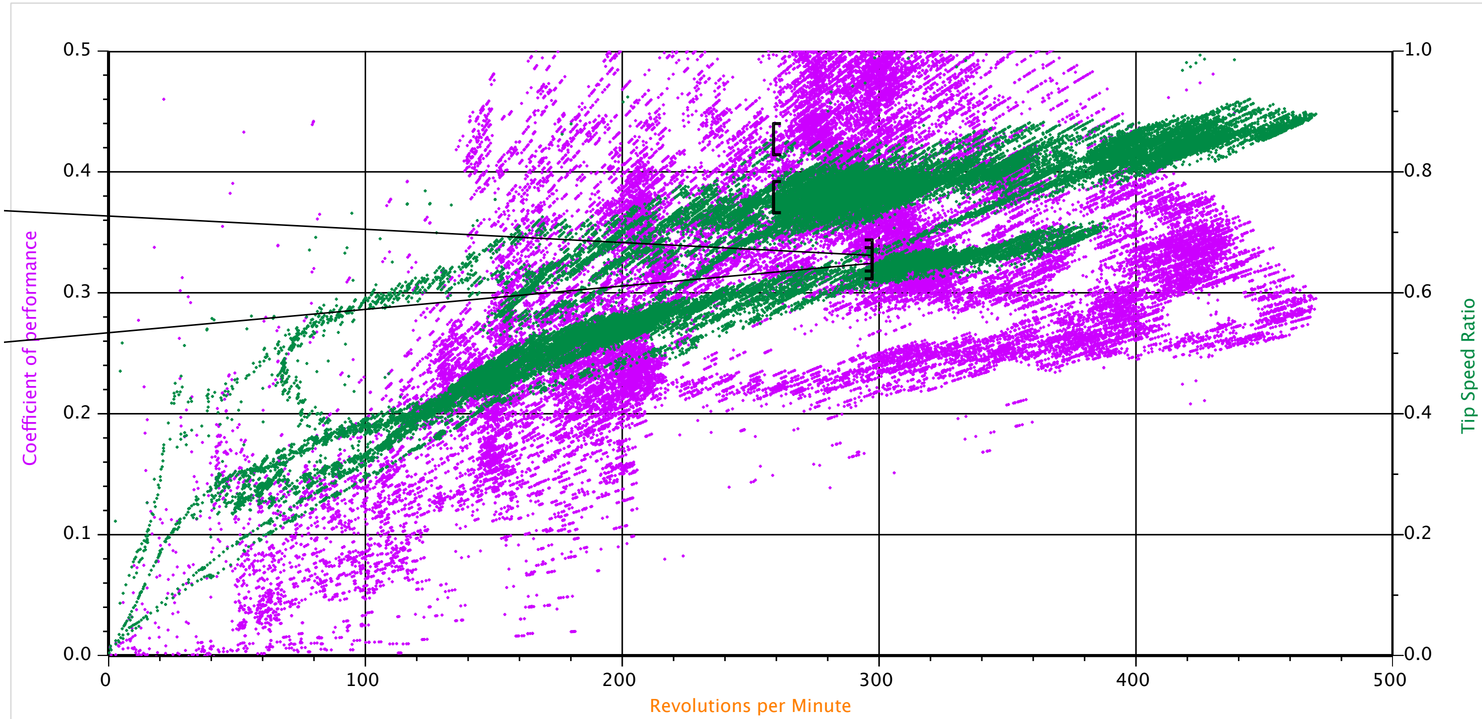
From this graph I understand that the 3 linear slopes of the RPM, Cp, TSR, align at RPM's of 280, with Cp of .38-.4 and TSR of . 76-8

Statistics for: Run 1 | Coefficient of performance
min: 0.1388 at 280.9 max: 0.6841 at 267.6
mean: 0.4145 median: 0.4047
std. dev: 0.08046 samples: 11652
Δy: 0.545

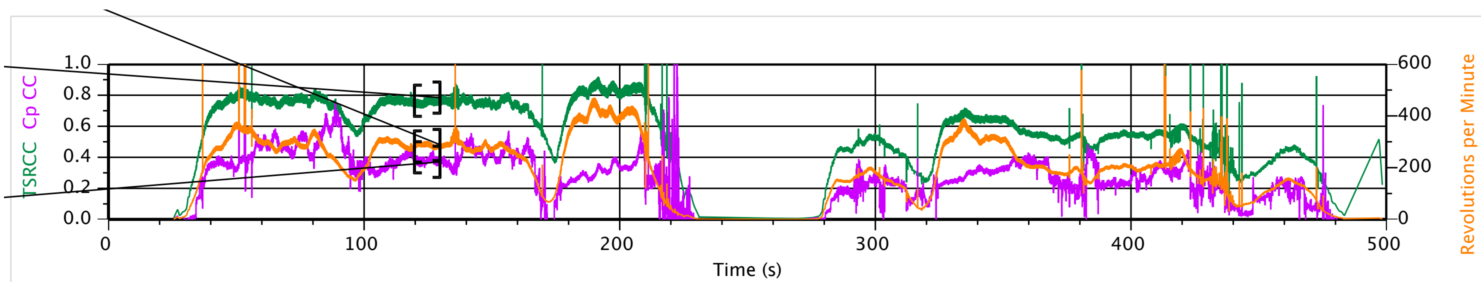
Statistics for: Run 1 | Tip Speed Ratio
min: 0.5644 at 262.0 max: 0.9468 at 294.5
mean: 0.7482 median: 0.7607
std. dev: 0.04956 samples: 11652
Δy: 0.382



Statistics for: Run 1 | Revolutions per Minute
min: 267.2 at 119.6 max: 303.0 at 123.6
mean: 288.9 median: 289.4
std. dev: 6.565 samples: 1869
Δy: 35.806

Statistics for: Run 1 | Tip Speed Ratio
min: 0.7138 at 122.2 max: 0.7978 at 130.0
mean: 0.7637 median: 0.7646
std. dev: 0.01490 samples: 1869
Δy: 0.084

Statistics for: Run 1 | Coefficient of performance
min: 0.3317 at 123.7 max: 0.4432 at 126.9
mean: 0.3832 median: 0.3828
std. dev: 0.01759 samples: 1869
Δy: 0.112



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What I take from this graph is that around the 250 rpm samples Cp of 0.25-0.31 frequently occurred alongside TSR's of 0.7. At higher revolutions the TSR increased, indicating higher capacity to carry load, and so a higher Cp could have been attained with a better load match.