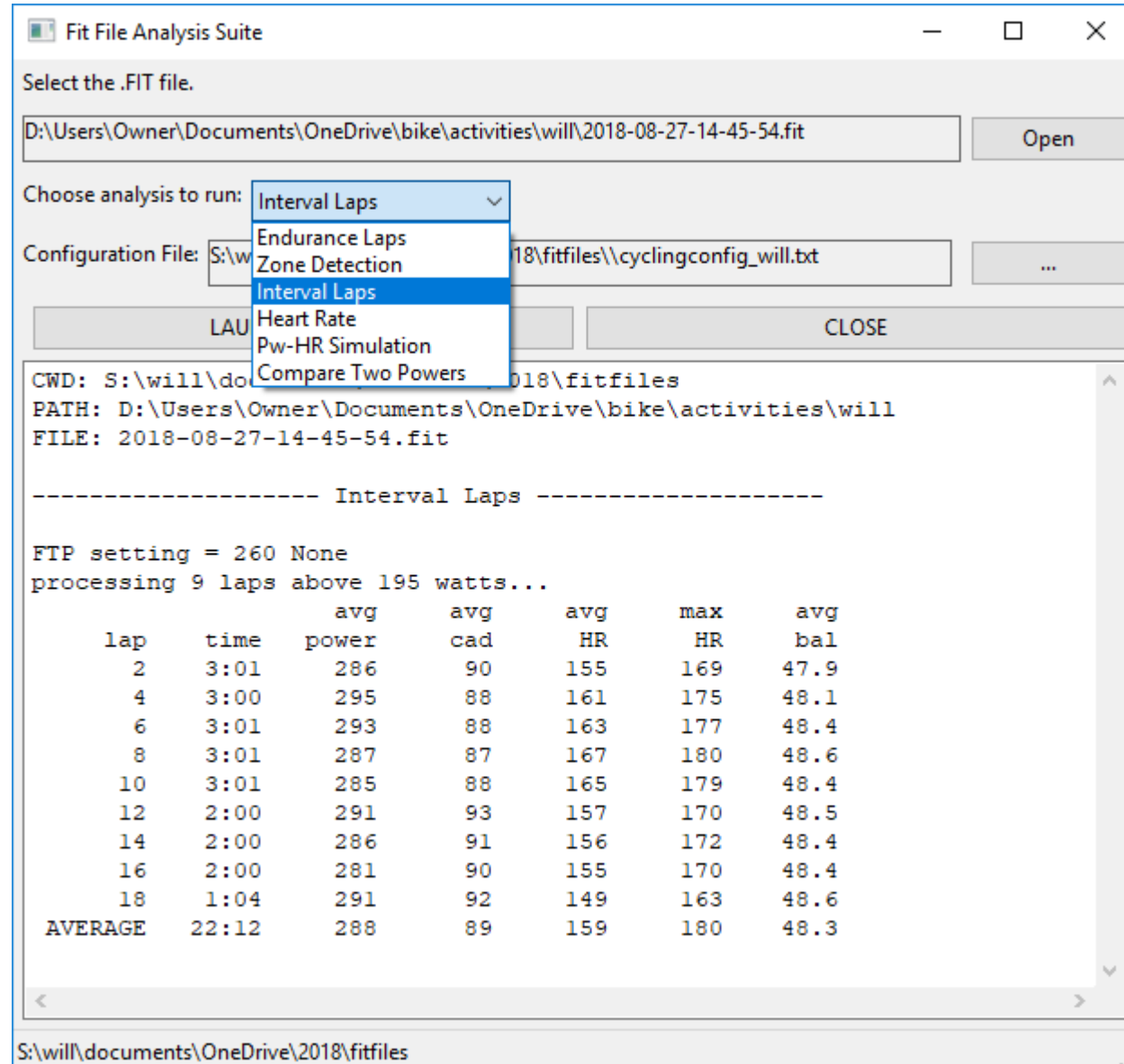


# FitFiles

WH Spicher

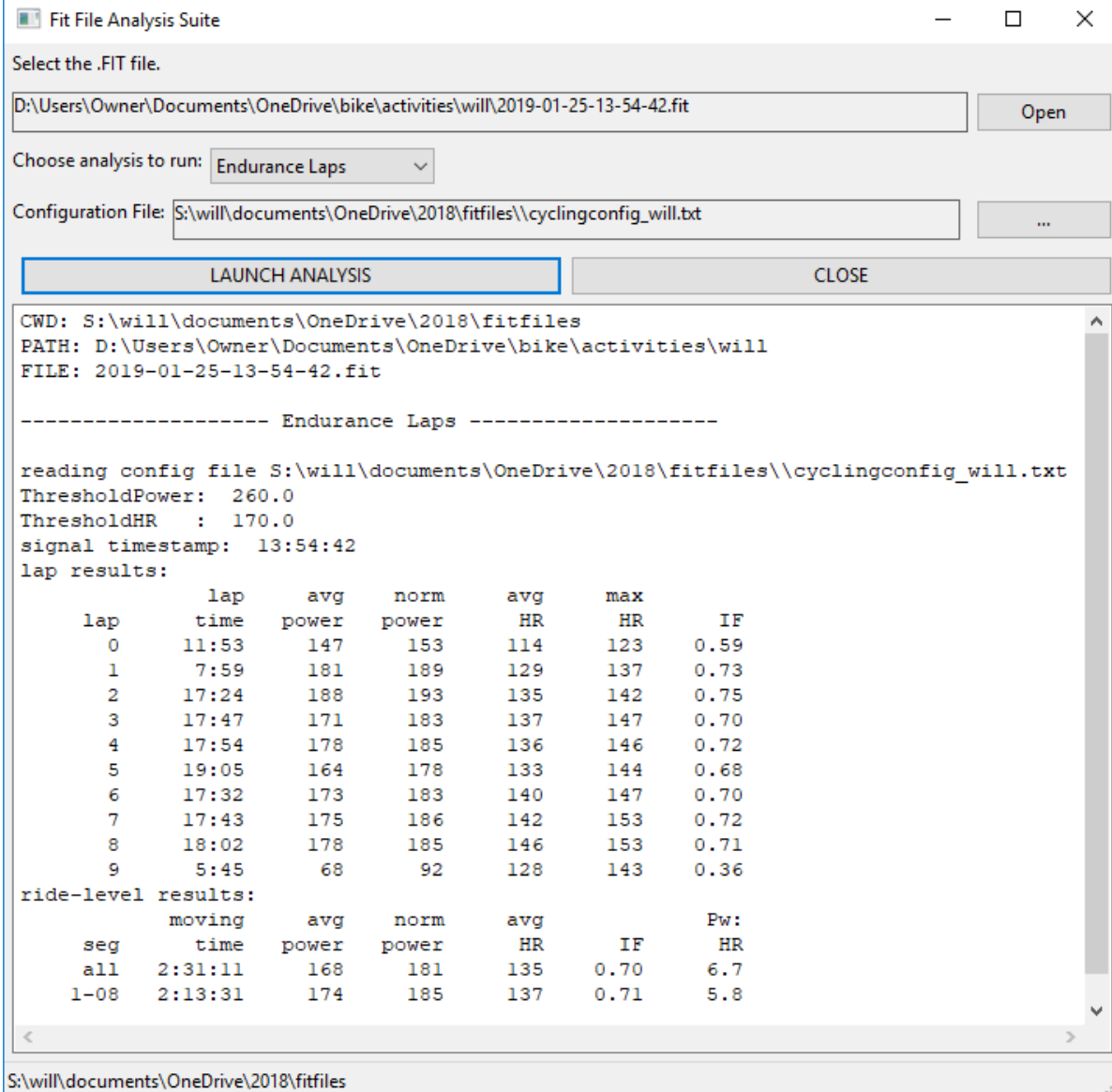
# FitFiles Project

- Fast access to a suite of custom tools for analyzing cycling workouts.
- Drag-drop support for .FIT files.
- Formatted text output for copy-pasting into workout diary.
- Support for user-configuration files.
- Available on GitHub (user: guitarsenall)



# FitFiles: Endurance Summary

- Print lap statistics to show progress.
- Print results for whole ride and inner laps (assume first and last lap are warmup and cooldown).



The screenshot shows the 'Fit File Analysis Suite' window. At the top, it prompts to 'Select the .FIT file.' with a text box containing 'D:\Users\Owner\Documents\OneDrive\bike\activities\will\2019-01-25-13-54-42.fit' and an 'Open' button. Below this, it asks to 'Choose analysis to run:' with a dropdown menu set to 'Endurance Laps'. A 'Configuration File' field shows 'S:\will\documents\OneDrive\2018\fitfiles\cyclingconfig\_will.txt' with a browse button. Two buttons, 'LAUNCH ANALYSIS' and 'CLOSE', are present. The main area displays the analysis results in a text-based format.

CWD: S:\will\documents\OneDrive\2018\fitfiles  
PATH: D:\Users\Owner\Documents\OneDrive\bike\activities\will  
FILE: 2019-01-25-13-54-42.fit

----- Endurance Laps -----

reading config file S:\will\documents\OneDrive\2018\fitfiles\cyclingconfig\_will.txt  
ThresholdPower: 260.0  
ThresholdHR : 170.0  
signal timestamp: 13:54:42

lap results:

lap	lap time	avg power	norm power	avg HR	max HR	IF
0	11:53	147	153	114	123	0.59
1	7:59	181	189	129	137	0.73
2	17:24	188	193	135	142	0.75
3	17:47	171	183	137	147	0.70
4	17:54	178	185	136	146	0.72
5	19:05	164	178	133	144	0.68
6	17:32	173	183	140	147	0.70
7	17:43	175	186	142	153	0.72
8	18:02	178	185	146	153	0.71
9	5:45	68	92	128	143	0.36

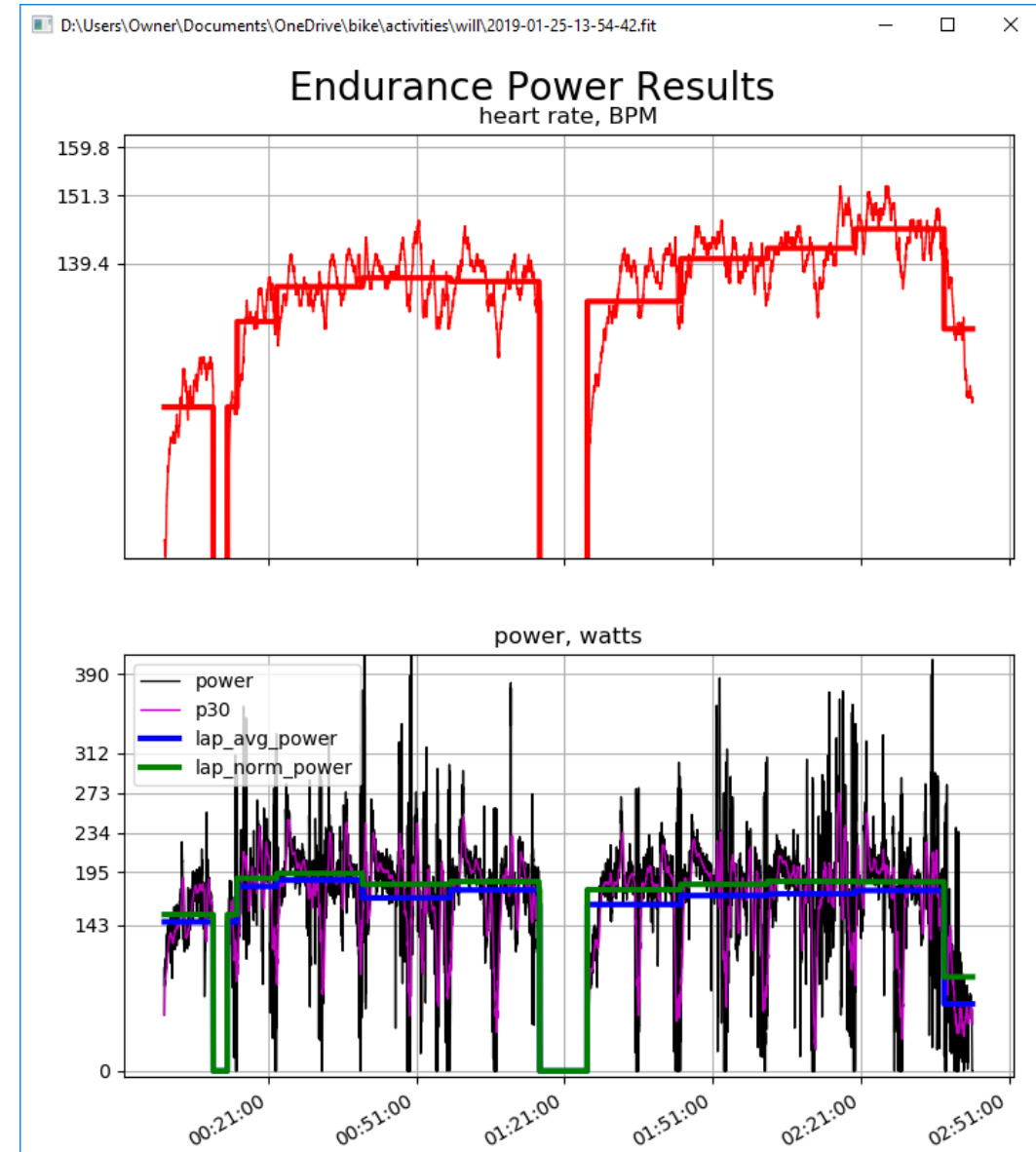
ride-level results:

seg	moving time	avg power	norm power	avg HR	IF	Pw: HR
all	2:31:11	168	181	135	0.70	6.7
1-08	2:13:31	174	185	137	0.71	5.8

The status bar at the bottom shows the path 'S:\will\documents\OneDrive\2018\fitfiles'.

# FitFiles: Endurance Summary

- Plot heart rate with grids at zone boundaries and lap averages.
- Plot raw and 30-second-average power with lap averages and grids at zone boundaries.



# FitFiles: Zone Detection Analysis

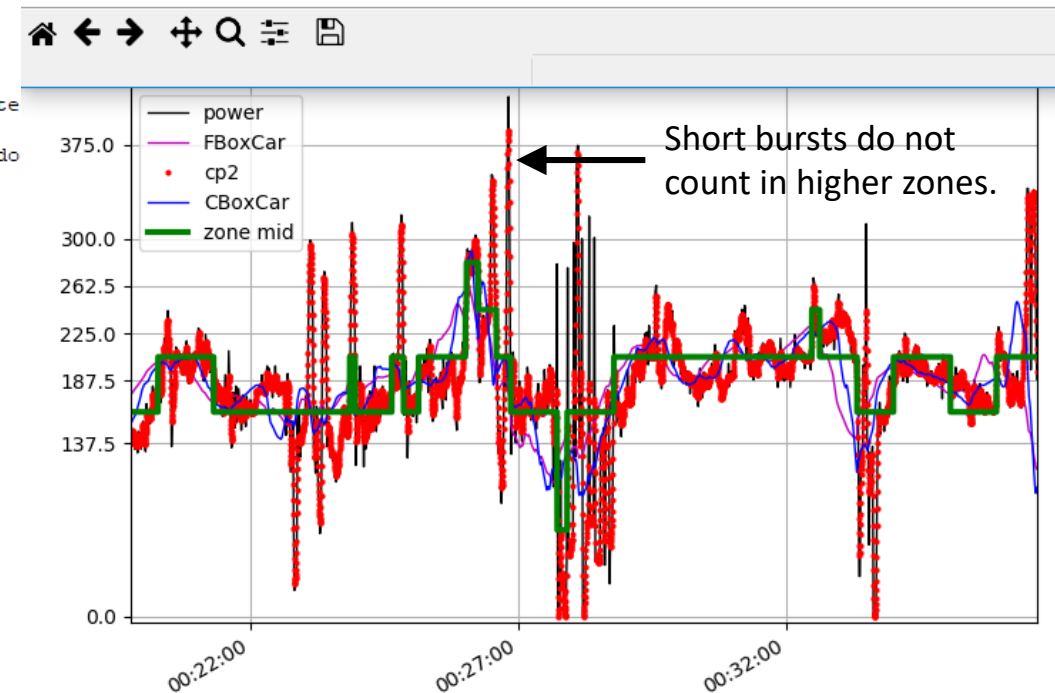
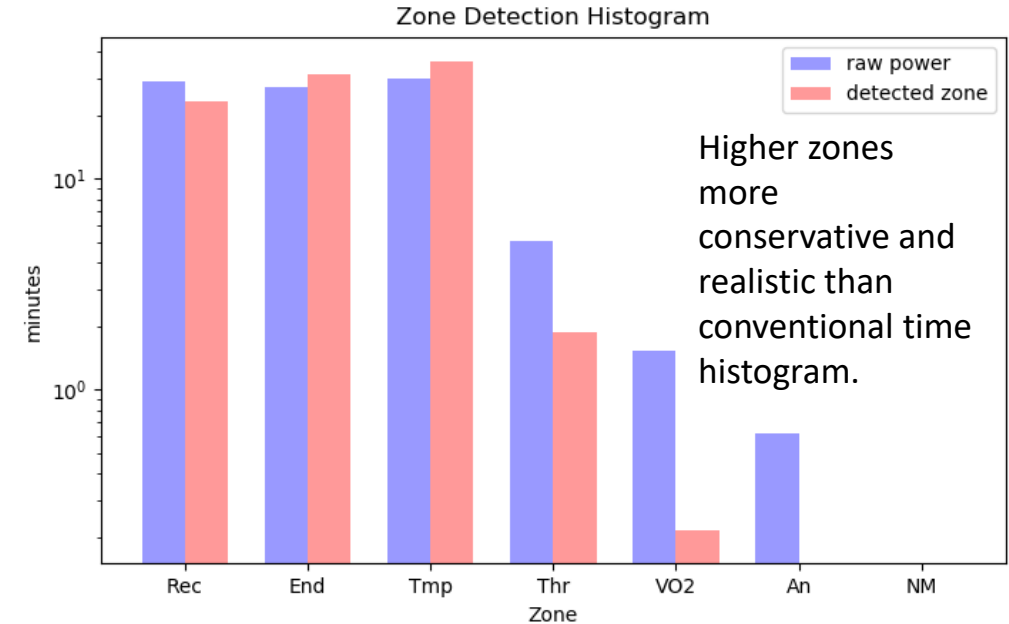
A better way of measuring time spent in power zones.

**Innovation:** To my knowledge, no one else offers this feature.

- Attaining a power zone should require more than spending one second at that power. Model as a state machine with transitions based on rules regarding time spent in new zone.
- Formatted print of histogram for training diary.

```
----- Zone Detection -----
reading config file S:\will\do
ThresholdPower: 260.0
ThresholdHR : 170.0
Power Zone Histogram:
Zone 1: 0:26:58 (28%)
Zone 2: 0:39:57 (42%)
Zone 3: 0:25:53 (27%)
Zone 4: 0:00:33 (0%)
Zone 5: 0:00:00 (0%)
Zone 6: 0:00:00 (0%)
Zone 7: 0:00:00 (0%)
total: 1:33:23
```

D:\Users\Owner\Documents\OneDrive\bike\activities\will\2018-12-22-16-28-06.fit



# Heartrate Simulation

Predict heartrate from power based on a first-order, linear ODE. Four parameters:

- Time constant: how quickly HR rises in response to power.
- Functional Threshold Power (FTP): Max power sustainable for one hour.
- Functional Threshold Heartrate (FTHR): Average heartrate during FTP.
- Drift rate. Cardiac drift proportional to fatigue (BPM/TSS).

$$\frac{dH}{dt} = \frac{1}{\tau} [H_T(p) + H_D F - H(t)]$$

Heartrate at  $t$

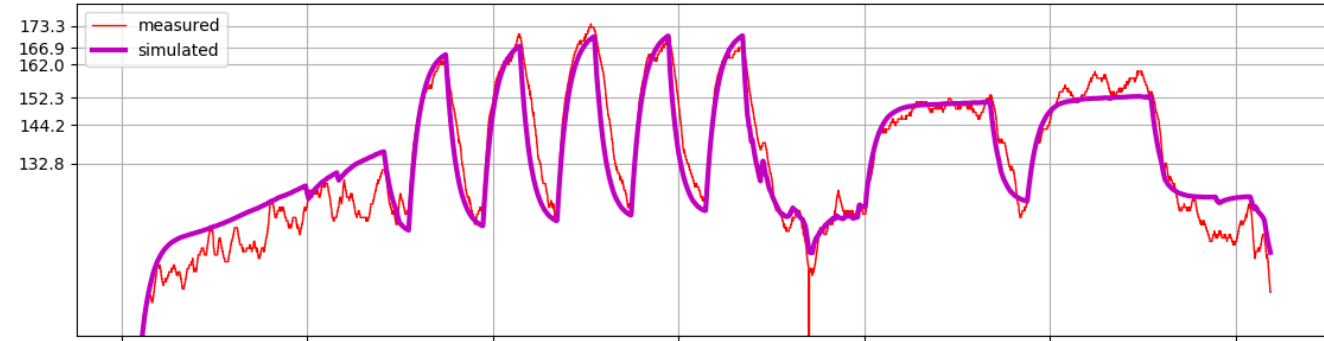
Heartrate drift-rate times fatigue (TSS at  $t$ )

Heartrate target: function of power at  $t$

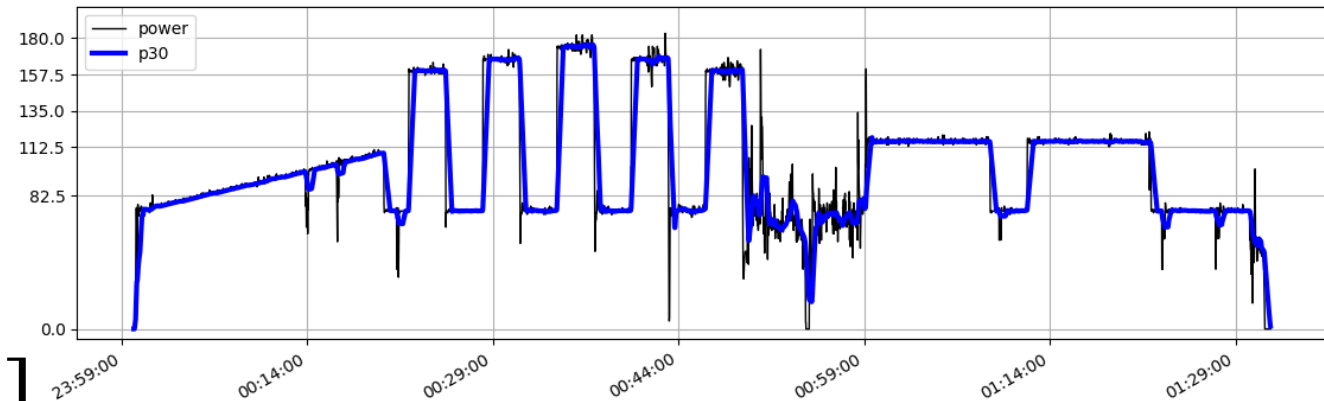
Time constant

Heartrate derivative at  $t$

Pw:HR Transfer Function  
heart rate, BPM



power, watts



Inspired by treadmill-control research:

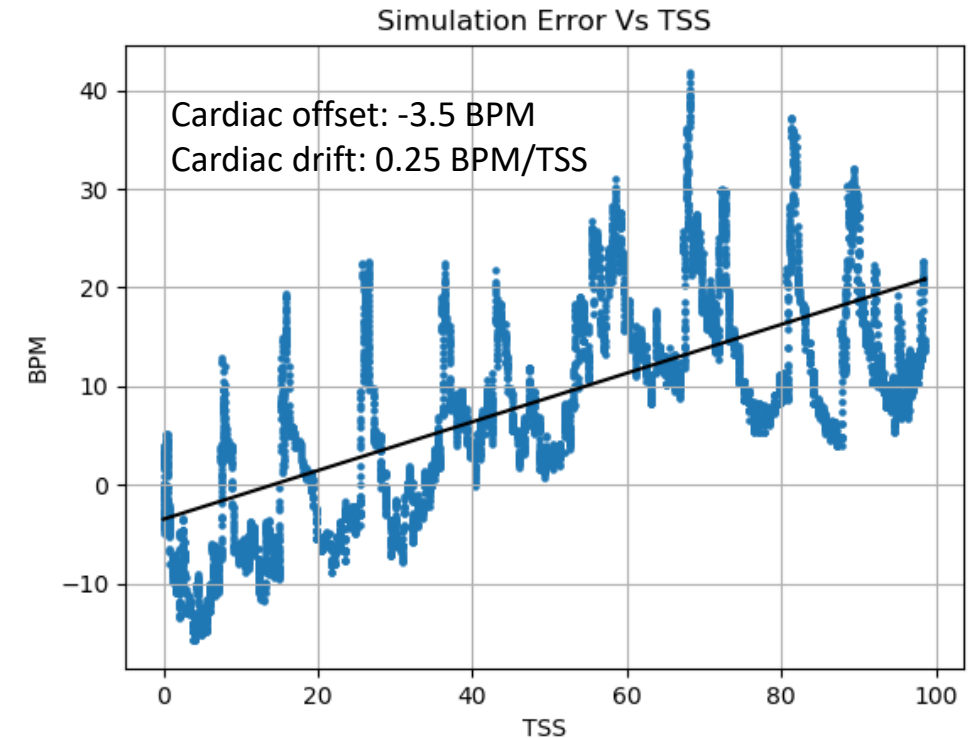
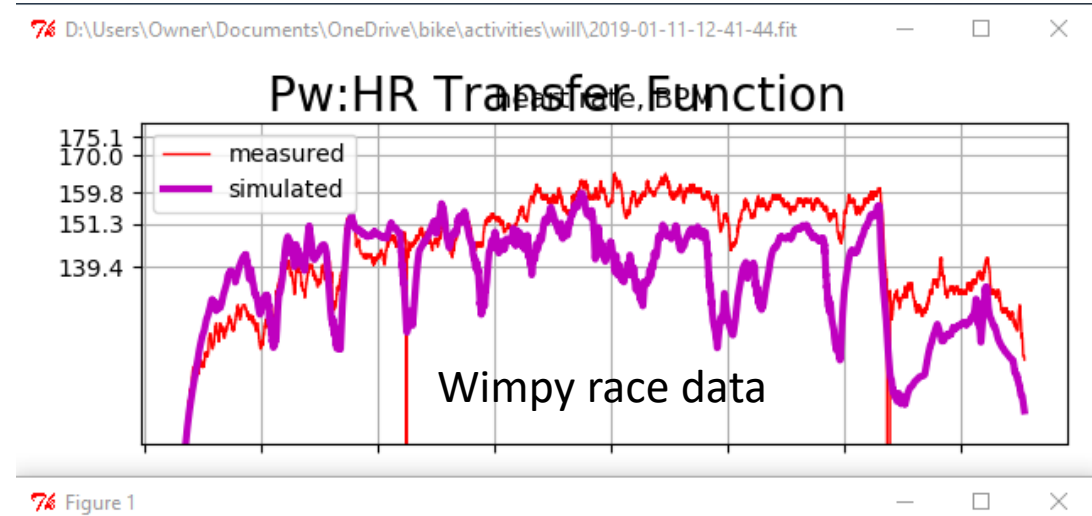
$$H(s) = \frac{k}{\tau s + 1} P(s)$$

# Heartrate Simulation

Provides a better estimate for two useful metrics which used to require a structured workout:

- Cardiac offset: How much higher or lower than normal is heartrate for a given workout?
- Cardiac drift:
  - Now modeled as proportional to fatigue (BPM/TSS) rather than a percentage over duration.
  - Available for ANY workout (e.g., racing); structured endurance workout not necessary.

**Innovation:** To my knowledge, no one else offers this feature.



# Heartrate Simulation

Also provides for going the other way—simulating power from heart rate!

- Estimate work, intensity, and TSS for workouts that lack a power signal.

**Innovation:** To my knowledge, no one else offers this feature.

