ISG Scripts Documentation

Release v2.0.0

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CONTENTS:

This repository houses scripts used to analyse data and generate plots for customer demos of ISG applications. PCAN traces are taken when cranking on vehicle.

Modules for PCAN trace files:

- firetrace
- deadtrace
- assist

Modules for Picoscope `.csv` files:

- speedtime module

CHAPTER

ONE

FIRETRACE

Firetraces are traces of engine starts taken with sparkplug.

```
{
"sym_file" : "Symbol_file_isg_assist_codebase.sym",
"trace_file" : "v13_working_more_clean_cranks.trc",
"vertical_speed_jump" : 550,
"jump_time_duration" : 0.03,
"idling_speed" : 1500,
"m_speed" : "Bemf_Speed_RPM",
"operation_mode" : "MEAS_OPMODE",
"battery_current" : "IDC_Estimated",
"battery_voltage" : "Vbat",
"u_theta" : "MEAS_UTHETA"
}
```

Example set of config, trace, and `.sym` files are config.json, trace.trc and symbol.sym. Command below is used to analyse firetrace taken from PCAN.

Listing 1: Command

```
isg.firetrace --config config.json
```

Description of config.json file:

- "sym_file" : Name of PCAN `.sym` file
- "trace_file" : Name of `.trc` file
- "speed_jump" : Speed jump in RPM at fire point. Motor-engine specific.
- "jump_time_duration" : Time in seconds required to achieve "vertical_speed_jump" at fire point.
- "m_speed" : Speed variable name in `.sym` file
- "operation_mode" : Op_mode variable name in `.sym` file
- "battery_current" : Ibat variable name in `.sym` file
- "battery_voltage" : Vbat variable name in `.sym` file
- "u_theta" : U_theta variable name in `.sym` file

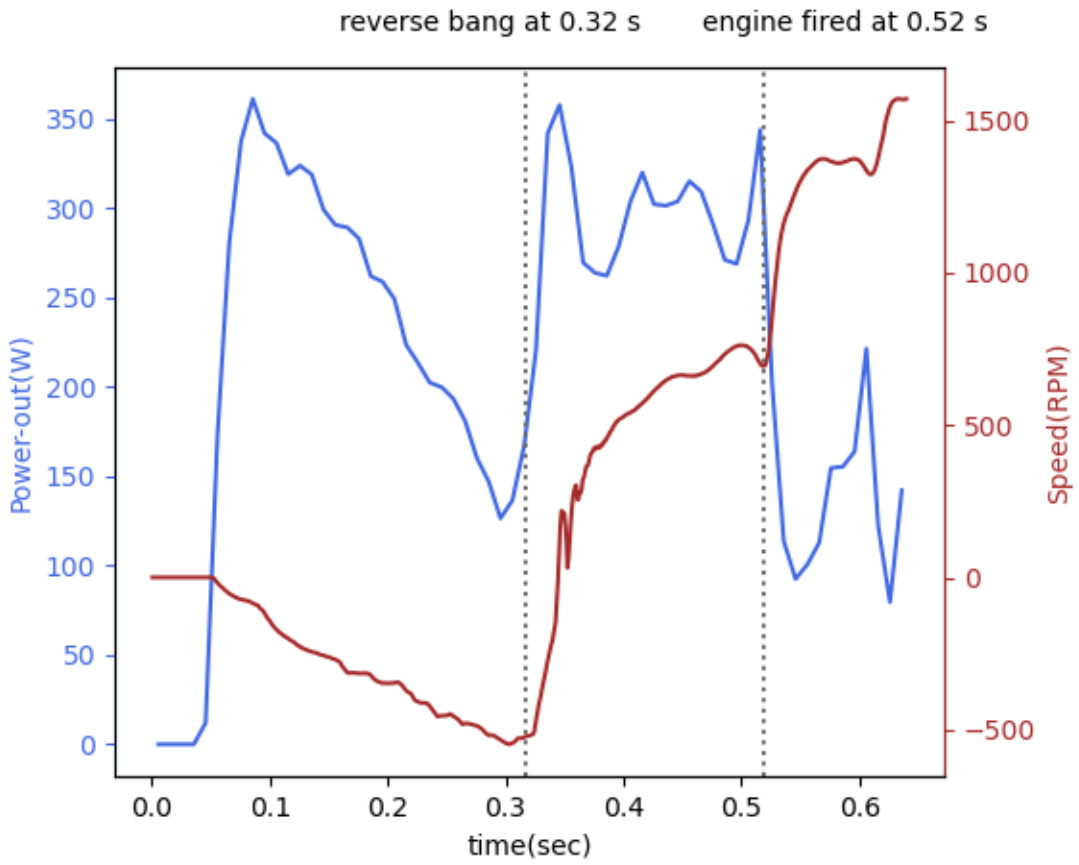
Description of script:

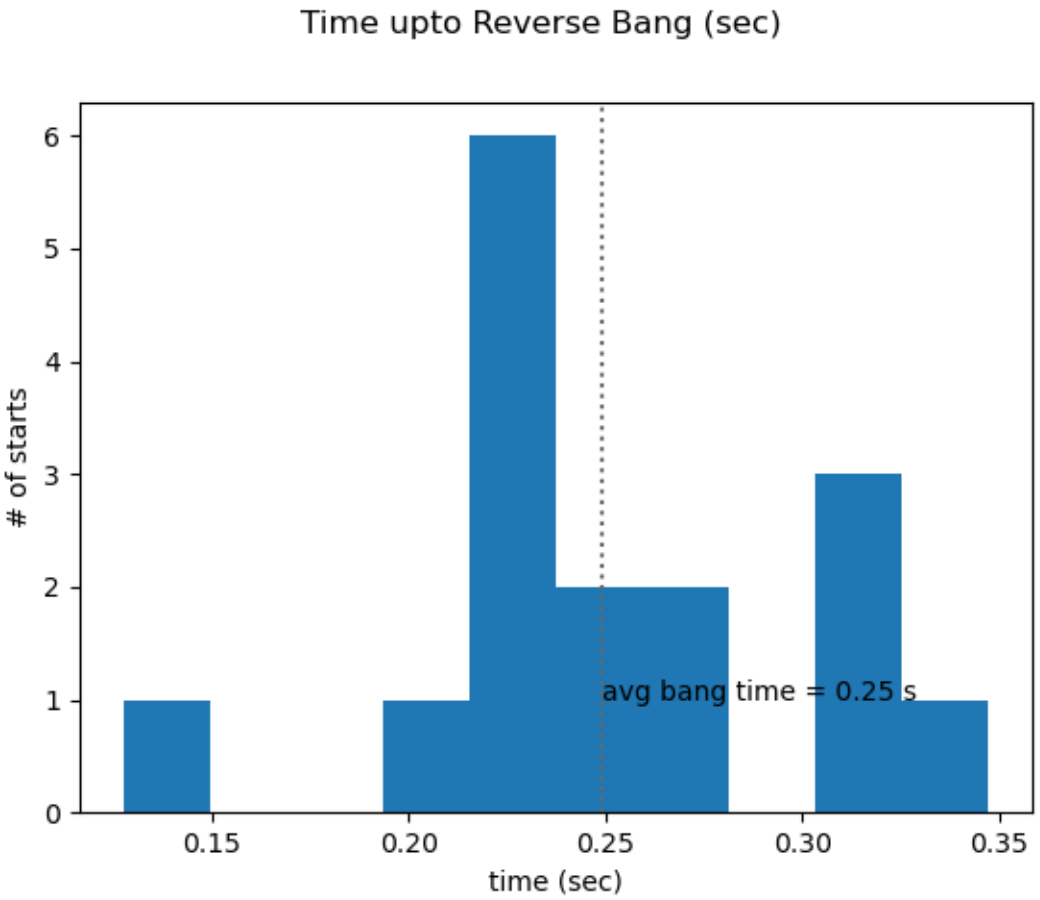
- Successful cranks detection based on op__mode
- For each successful crank

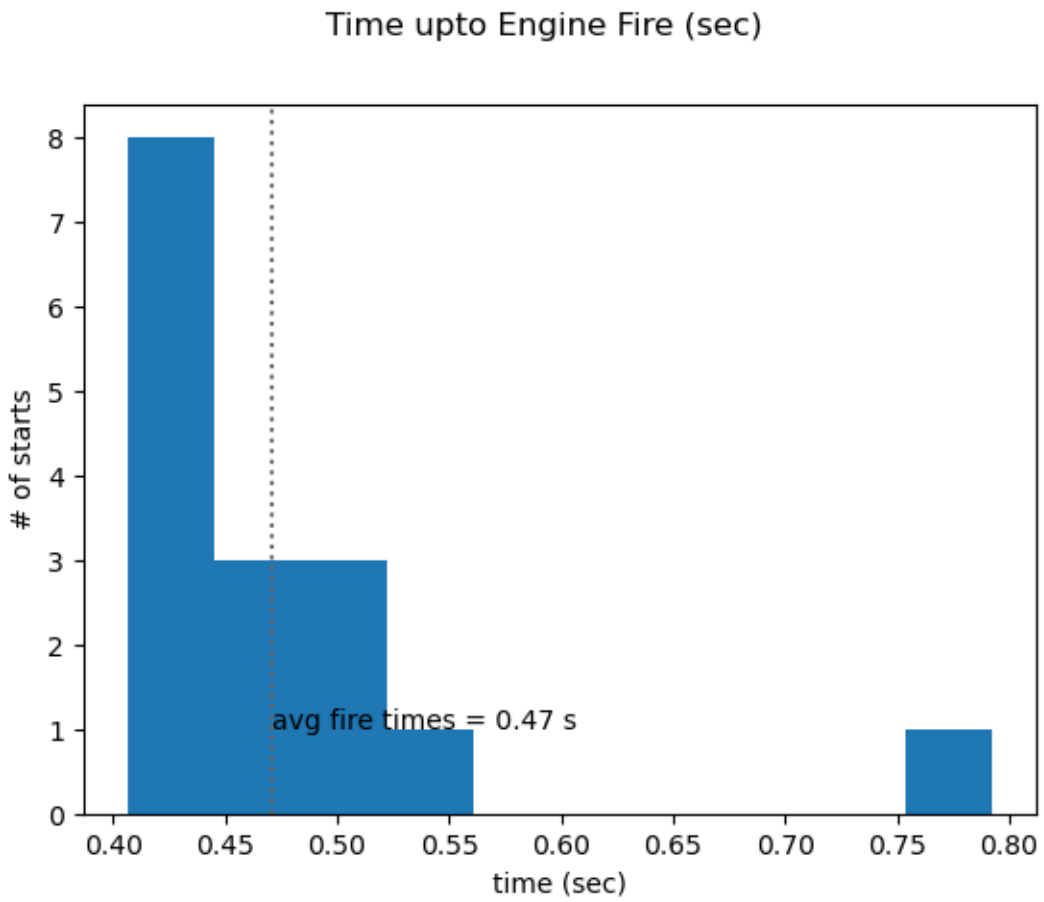
  - Calculate reverse bang time based on utheta
  - Engine-fire-time based on jump in speed

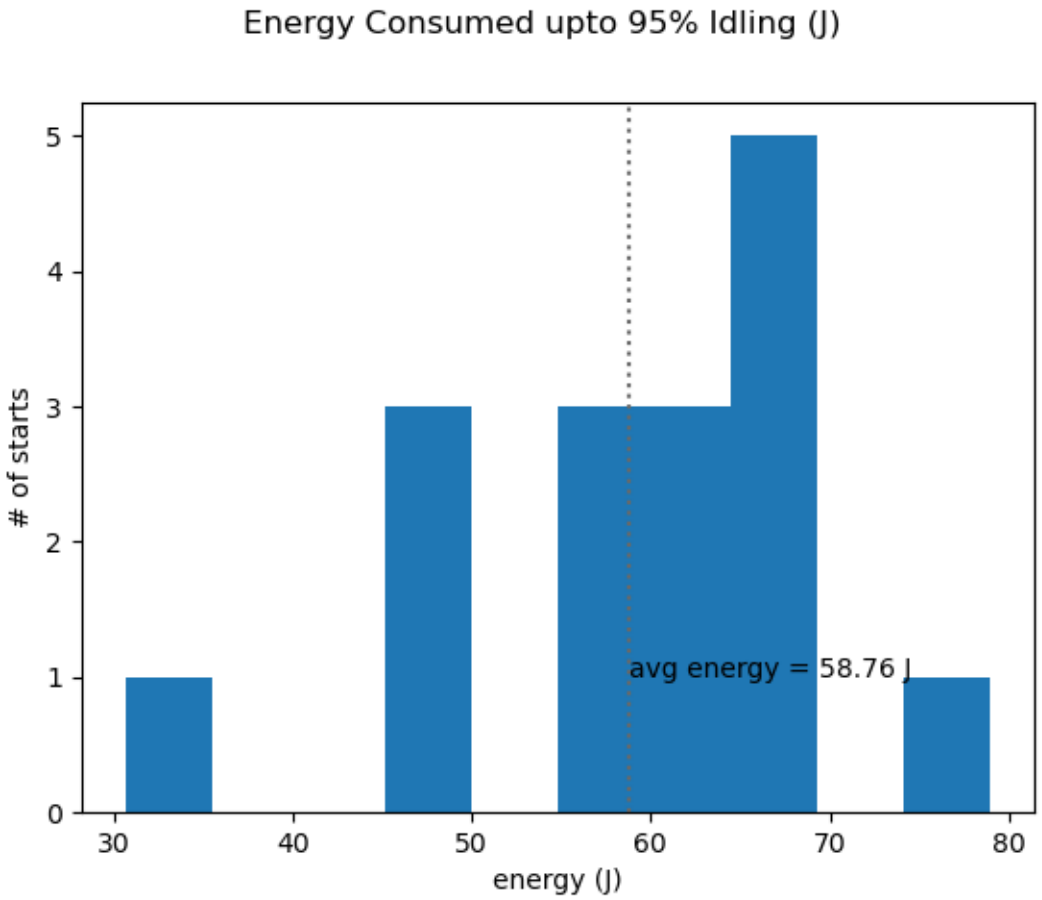
- Jump detection requires engine-motor specific parameter `speed_jump`. 550 RPM in 0.03 seconds is for NTorq.
- The value of `jump_time_duration` should be increased if m_speed data transmits are sparse.

Figure outputs are saved in folder named `isg_plots` created at terminal location. A sample subset of the figures is shown below.




Time upto Reverse Bang (sec)
# of starts
time (sec)
avg bang time = 0.25 s
0
1
2
3
4
5
6
0.15
0.20
0.25
0.30
0.35


Time upto Engine Fire (sec)
# of starts
time (sec)
avg fire times = 0.47 s
0
1
2
3
4
5
6
7
8
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80



Text-output is written in `firetrace_output.csv` file at terminal location.

CHAPTER

TWO

DEADTRACE

Deadtraces are taken with sparkplug removed. Example `config.json` file is shown below:

```
{
"sym_file" : "Symbol_file_isg_assist_codebase.sym",
"trace_file" : "true_dead_cranks_v13.trc",
"m_speed" : "Bemf_Speed_RPM",
"operation_mode" : "MEAS_OPMODE",
"battery_current" : "IDC_Estimated",
"battery_voltage" : "Vbat",
"u_theta" : "MEAS_UTHETA",
"ia" : "IA"
}
```

Example set of config, `trace_file`, and `sym_file` files are config.json, trace.trc and symbol.sym.

Command below is used to analyse deadtrace taken from PCAN.

Listing 1: Command

```
isg.deadtrace --config deadconfig.json
```

Description of config.json file:

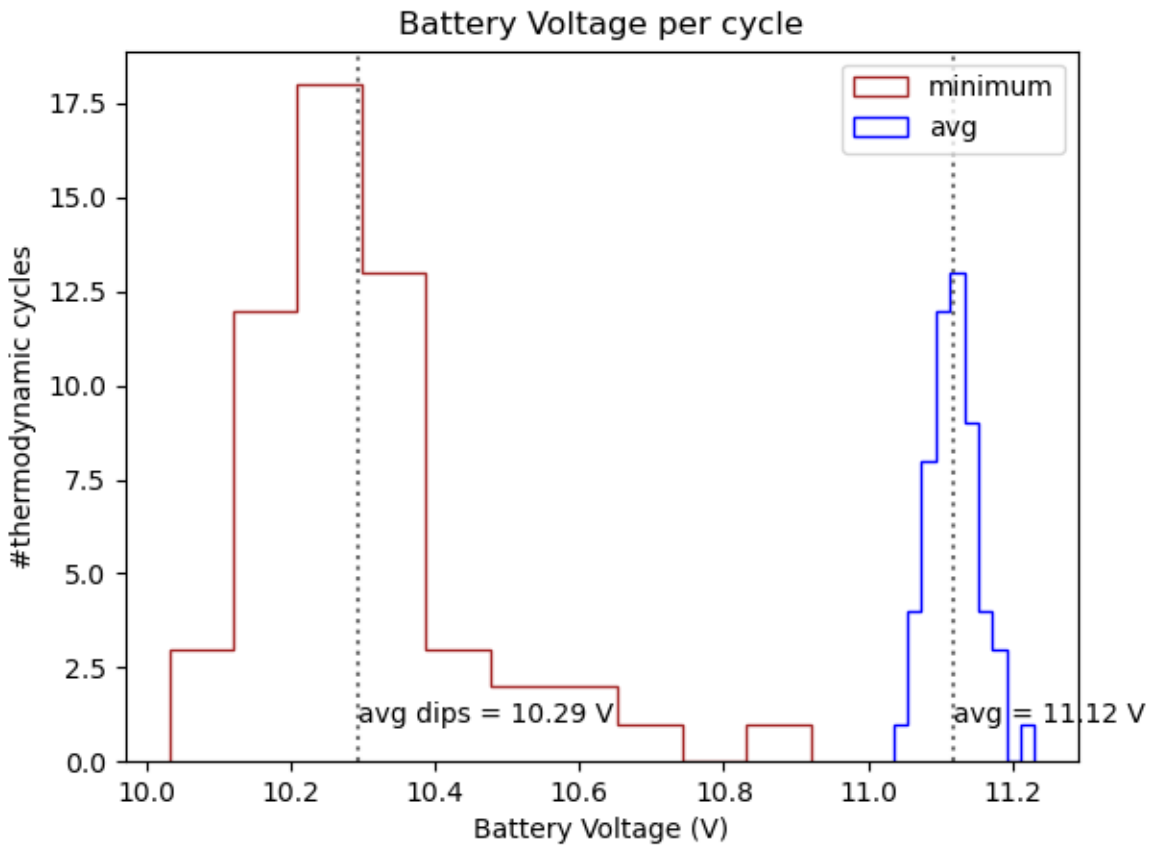
- "sym_file" : Name of PCAN `.sym` file
- "trace_file" : Name of `trace` file
- "m_speed" : Speed variable name in `.sym` file
- "operation_mode" : Op_mode variable name in `.sym` file
- "battery_current" : Ibat variable name in `.sym` file
- "battery_voltage" : Vbat variable name in `.sym` file
- "u_theta" : U_theta variable name in `.sym` file
- "ia" : Phase current variable name in `.sym` file

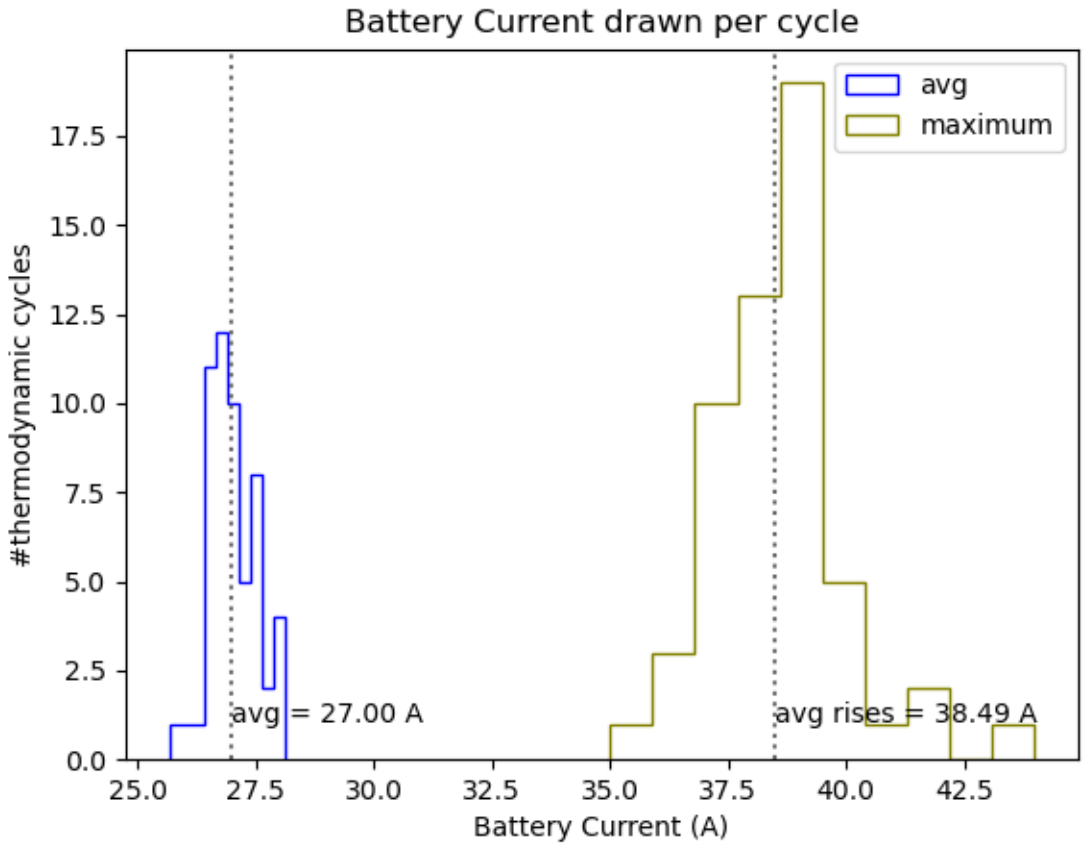
Description of script:

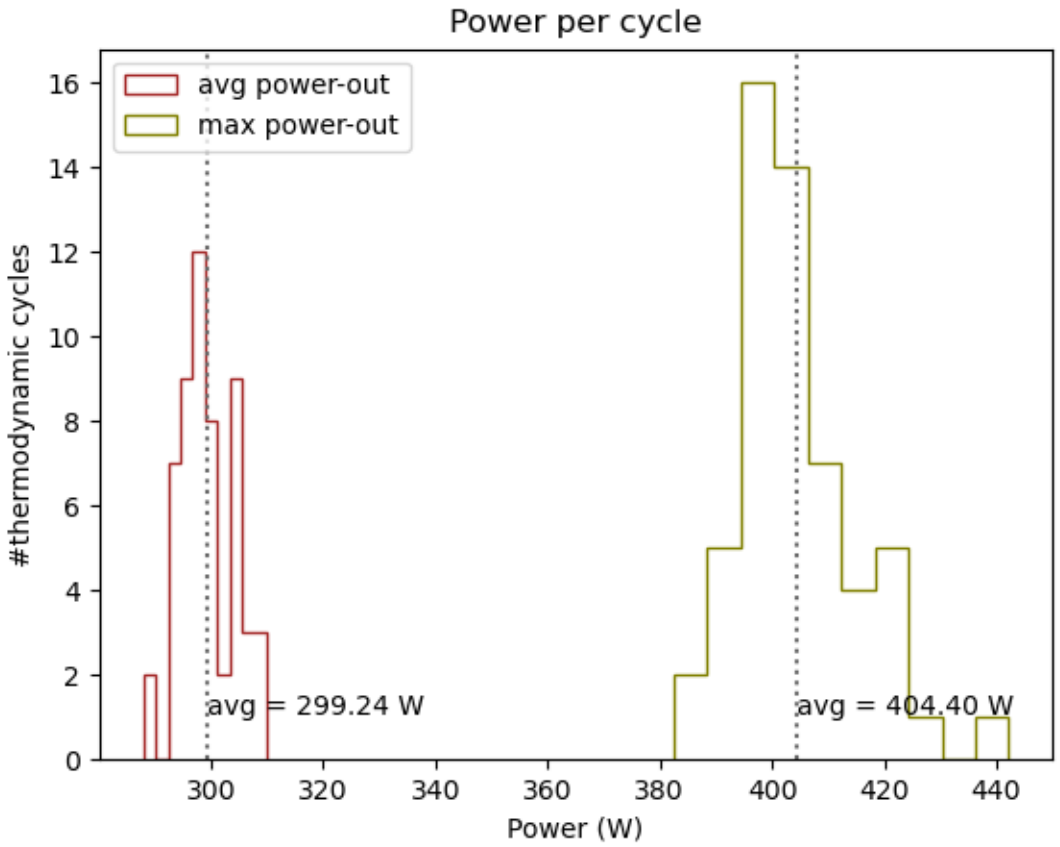
- Script calculates reverse bang time based on utheta.
- Sci-py is used to find compression times to isolate thermodynamic cycles.
- Statistics of power drawn from the battery, battery-current, battery-voltage and energy consumed per cycle are generated.
- At every compression, current drawn from battery is maximum and battery voltage dips to a minimum.

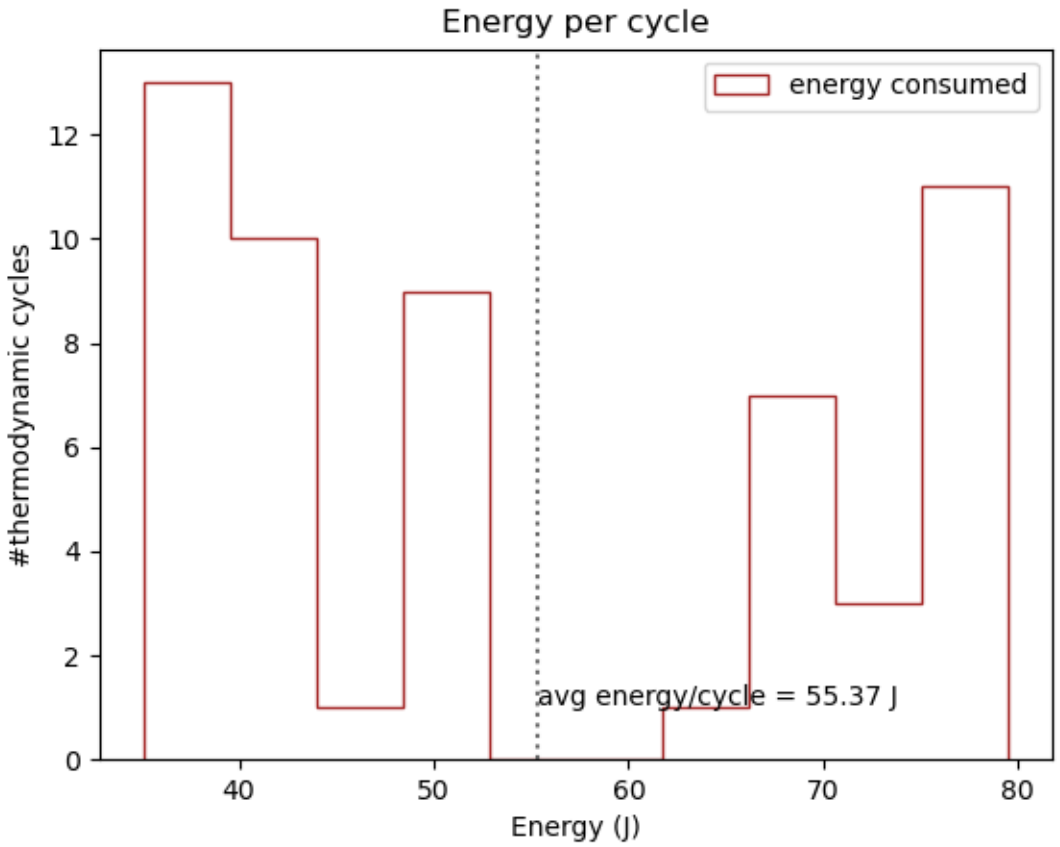
- Thus, statistics include maximum, mean of ibat and minimum, mean of vbat.

Figure output is placed in folder named `isg_plots` created at the location of terminal initiation. A sample subset of the output-figures is shown below.




Battery Current drawn per cycle
avg
maximum
#thermodynamic cycles
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
avg = 27.00 A
avg rises = 38.49 A
25.0
27.5
30.0
32.5
35.0
37.5
40.0
42.5
Battery Current (A)


Power per cycle
avg power-out
max power-out
#thermodynamic cycles
Power (W)
avg = 299.24 W
avg = 404.40 W
0
2
4
6
8
10
12
14
16
300
320
340
360
380
400
420
440



Text-output include line rms maximum and average written in `deadtrace_output.csv` file at terminal location.

CHAPTER

THREE

ASSIST

The following command is used to analyse assist and charging efficiency taken from PCAN. The trace files contains charging or assist.

```
{
    "begin_time" : [11, 54, 24],
    "end_time" : [11, 54, 25],
    "Rs" : 33.5,
    "sym_file" : "Symbol_file_isg_assist_codebase.sym",
    "trace_file" : "assist_test_24nov.trc",
    "battery_current" : "IDC_Estimated",
    "battery_voltage" : "Vbat",
    "assist_state" : "Assist_State",
    "ia" : "IA",
    "ib" : "IB",
    "ic" : "IC",
    "charge_state" : "Charging_State",
    "a_or_c" : "a"
}
```

Example set of config, trace, and `.sym` files are config.json, trace.trc and symbol.sym.

Command below is used to analyse trace taken from PCAN.

Listing 1: Command

```
isg.assist --config assist.json
```

Description of config.json file:

- "sym_file" : Name of PCAN `.sym` file
- "trace_file" : Name of `.trc` file
- "begin_time" : Speed jump in RPM at fire point. Motor-engine specific.
- "end_time" : Time in seconds required to achieve "vertical_speed_jump" at fire point.
- "Rs" : Phase resistance in mOhm of the motor
- "a_or_c" : Assist "a" or charging mode "c"
- "operation_mode" : Op_mode variable name in `.sym` file
- "battery_current" : Ibat variable name in `.sym` file
- "battery_voltage" : Vbat variable name in `.sym` file

- "assist_state" : Assist state variable name in `.sym` file
- "charge_state" : Charging state variable name in `.sym` file
- "ia" : Phase current A in `.sym` file
- "ib" : Phase current B in `.sym` file
- "ic" : Phase current C in `.sym` file

Energy from battery:

- e_bat = Vbat.Ibat.t

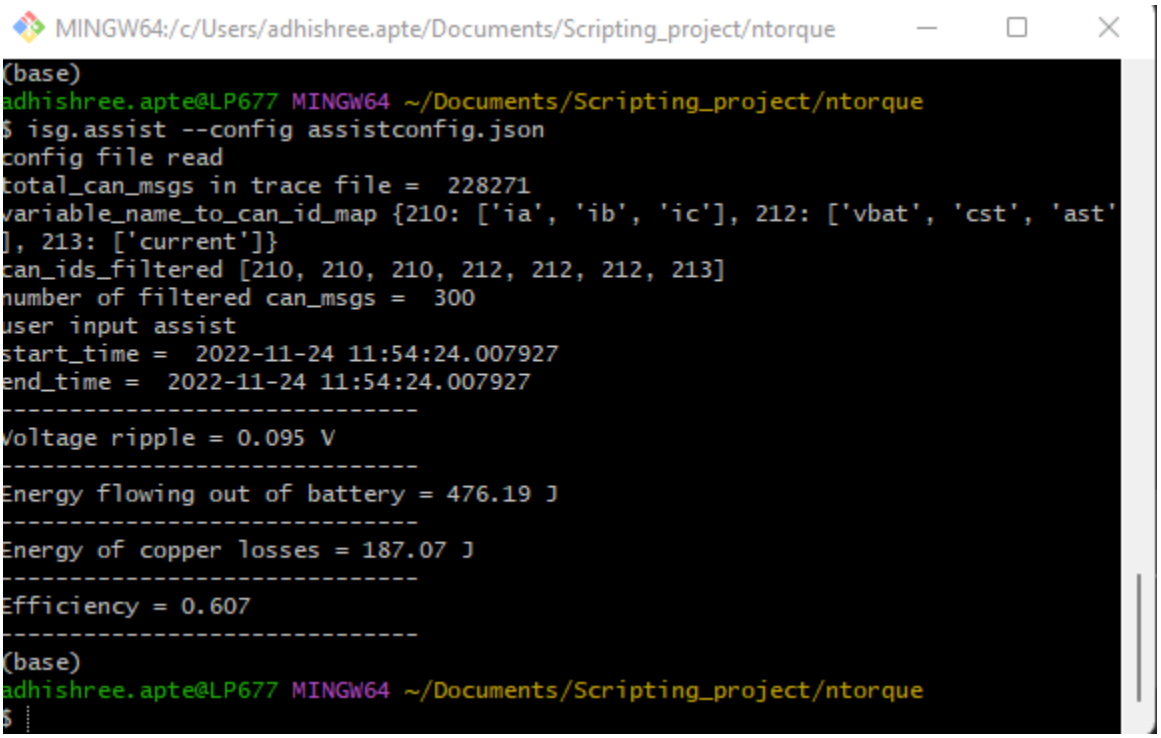
Copper loss:

- e_loss = Rs.(ia^2 + ib^2 + ic^2)t

Efficiency:

- Charging-
  - eta = -1*e_bat/(-1*e_bat + e_loss)
- Assist-
  - eta = 1 - (e_loss/e_bat)

Voltage ripple, efficiency, energy from battery and copper loss values are printed on command line. Sample output is in figure below :



CHAPTER

FOUR

SPEEDTIME

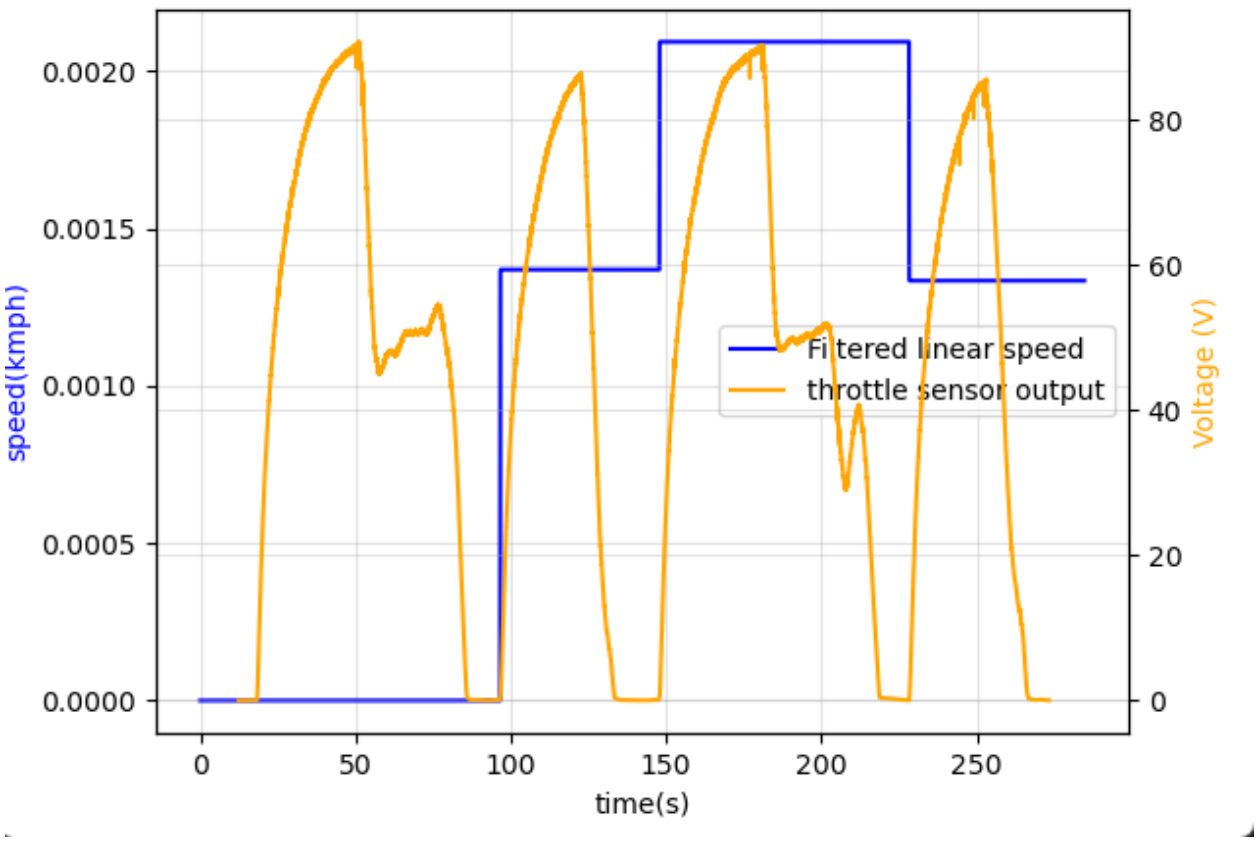
Command below is used to analyse csv files created from data taken on Picoscope.

Listing 1: Command

```
isg.speedtime --file_name picodata.csv
```

Example `.csv` file is pico_data.csv.

Output filtered speed is populated in `output_speedtime.csv`. Plot is saved in folder named "isg_plots" created at location of terminal.



CHAPTER

FIVE

CODEBASE

Download page: https://bitbucket.org/sedemac/isg_scripts/src/master/

CHAPTER

SIX

INDICES AND TABLES

- genindex
- modindex
- search