TurbLab: Turbulence Measurements with Hot Wire Anemometry

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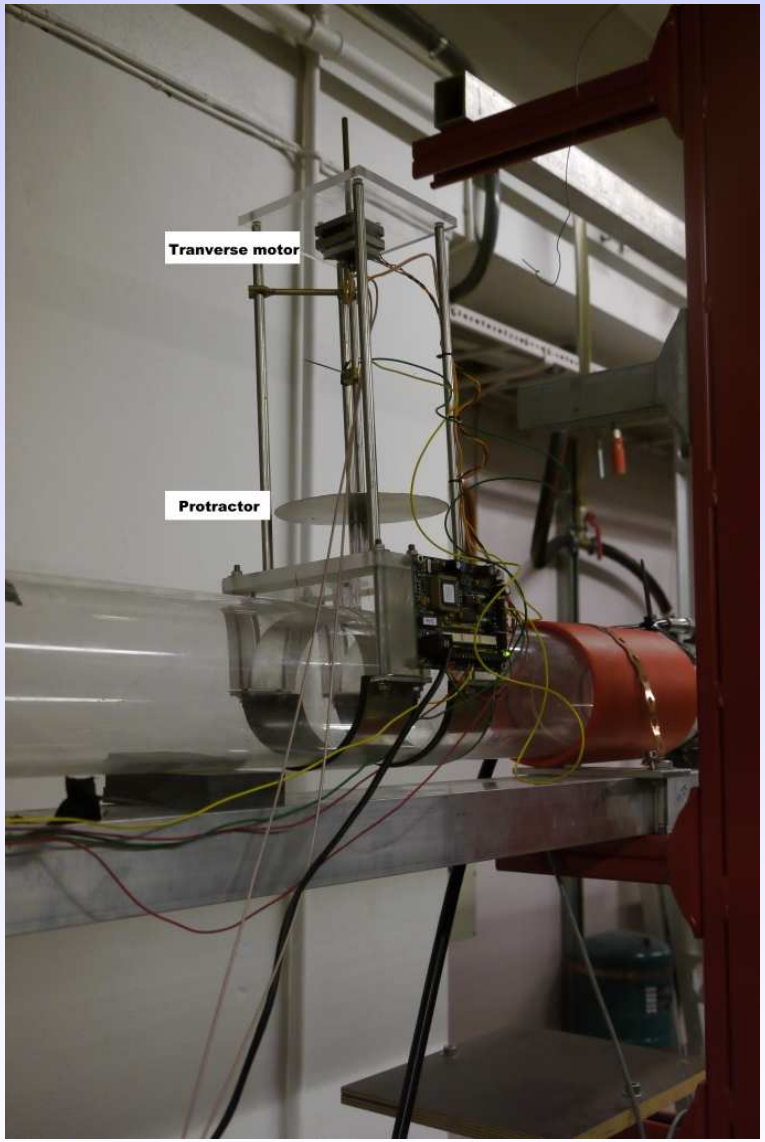
Hot Wire Section - UW-Probe



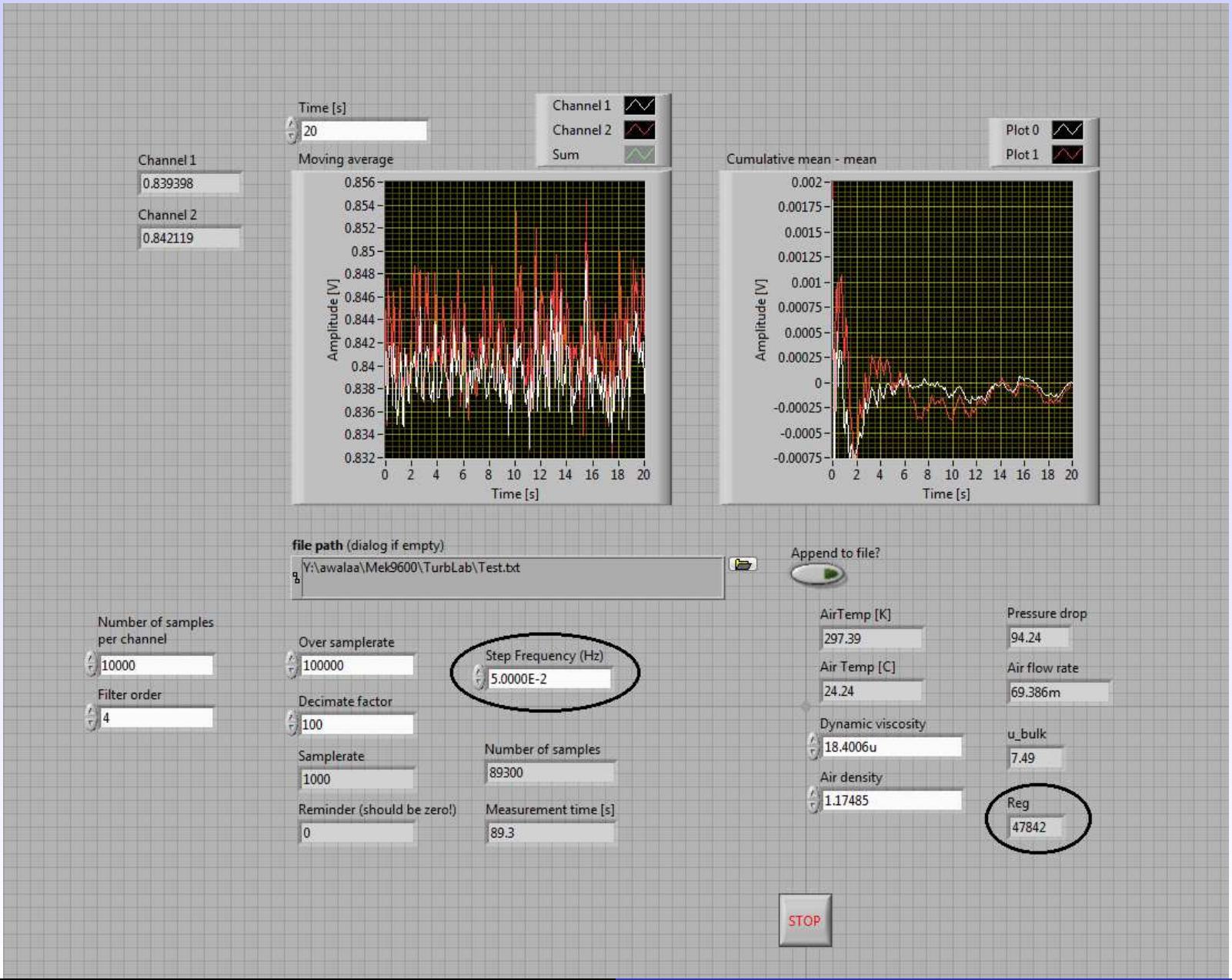
Goals

- Understand the basic principles of Hot Wire Anemometry. (Murat)
- Gain basic knowledge about turbulence. At least from a statistical point of view. (Murat)
- Learn how to use various control and processing softwares in a Hot Wire experiment. (Labview, Moons, Matlab ...).
- How to apply statistical tools on raw data in order to obtain mean and turbulence quantities, integral time scale, frequency spectra, etc.
- How to scale the results properly in order to compare with other people's work.

Pre-Tasks

- Understand the various features of the LabView program (Only Front Panel). (Samplerate, Convergence test, Electric motor frequency, ++).

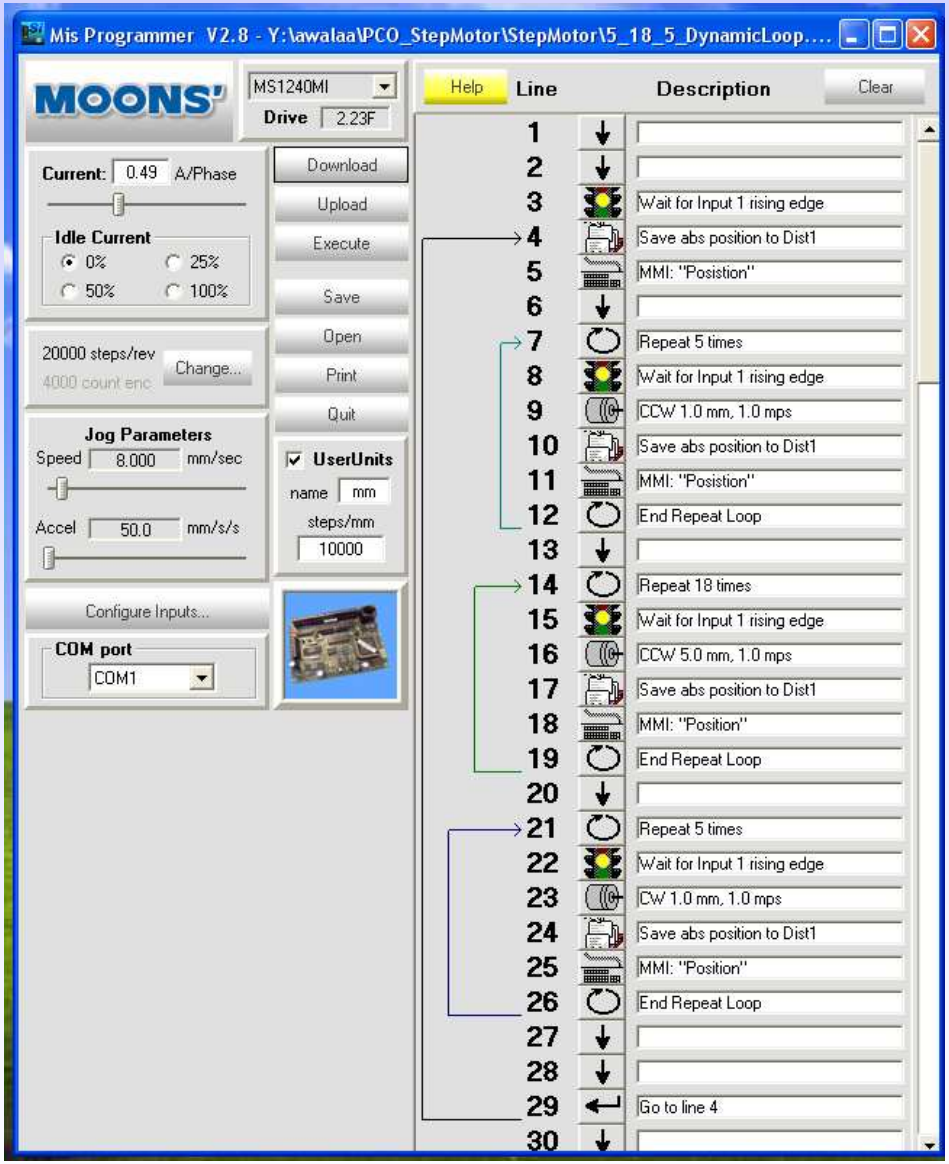
LabView Front Panel



Pre-Tasks

- Understand the various features of the LabView program (Only Front Panel). (Samplerate, Convergence test, Electric motor frequency, ++).
- Learn how to use the step motor software.

Step Motor Software



Pre-Tasks

- Understand the various features of the LabView program (Only Front Panel). (Samplerate, Convergence test, Electric motor frequency, ++).
- Learn how to use the step motor software.
- $[V] \longrightarrow [m/s]$ calibration (An additional note will be attached):
  - Centerline calibration. Six flowrates.
  - Use Nikuradse's interpolation method to find U_c from U_b. Matlab functions will be given.

Main Tasks

- Adjust the air fan frequency such that $Re_g \simeq 44000$ and set the step motor frequency to 0.05Hz.
- Perform a 5-18-5-points measurement at $Re_g \simeq 44000$.
  - $5 \times 1mm$ near top, $18 \times 5mm$ in main pipe, $5 \times 1mm$ near bottom. (StepMotor program is given)
- Convert signals from $[V] \longrightarrow [m/s]$ using the calibration constants.
- Extract horizontal and azimuthal mean and rms components.

Main Tasks

- Compute U_b and U_τ with the function "UbUtRe.m".
- Compare with DNS-data given by Wu and Moin. (Will be given).
- Compute the autocorrelation function $\beta(\tau)$ and integral time scale I at the point of maximum turbulence intensity.
- Compute the frequency spectrum $S(f)$ at that same point.
- (Optional) Repeat the latter two tasks at the pipe center.

Data text file

Channel 1	Channel 2	Temperature	Mass Flow Rate	Pressure Drop	Time
0.72273577	0.72112585	258.67462757	0.02754746	76.39723615	0.00000000
0.83176982	0.82685902	297.31643740	0.06887937	93.55833714	0.00100000
0.83218613	0.82603829	297.37116789	0.06885106	93.51461065	0.00200000
0.83188444	0.82663774	297.33510230	0.06900694	93.40990547	0.00300000
0.83086443	0.82781611	297.33696847	0.06891937	93.49531760	0.00400000
0.83073186	0.82905015	297.33691561	0.06903685	93.45523648	0.00500000
0.83049275	0.82673965	297.33691519	0.06905623	93.45187179	0.00600000
0.83007615	0.82700641	297.33691531	0.06884728	93.55952116	0.00700000
0.83175399	0.82643996	297.33691531	0.06885551	93.45603828	0.00800000
0.83380320	0.82638759	297.33691531	0.06890651	93.52564786	0.00900000
0.83916705	0.82926385	297.33691531	0.06887579	93.43972663	0.01000000
0.83962251	0.83087801	297.33691531	0.06906040	93.45388007	0.01100000
0.83624320	0.82506296	297.33691531	0.06901626	93.56750181	0.01200000
0.83394267	0.82429590	297.33691531	0.06892640	93.51795253	0.01300000
0.83351522	0.82629479	297.33691531	0.06908536	93.47418792	0.01400000
0.83832799	0.83102387	297.33691531	0.06889071	93.51613779	0.01500000
0.84049778	0.82749199	297.33691531	0.06893862	93.56152368	0.01600000
0.84501146	0.82607923	297.33691531	0.06883711	93.46494969	0.01700000
0.85993919	0.83127150	297.33691531	0.06907597	93.49231949	0.01800000
0.85273973	0.83854126	297.33691531	0.06900463	93.54663527	0.01900000

Typical Profiles