Exercise 5
Fuid Dynamics II SS 2022

18.5.2022

1 Exercise: Wind tunnel measurement

Choose randomly one of the datasets in the folder wind_data/LCA, which were measured at 20kHz and in m/s.

- Calculate the mean and standard deviation.
- Using Taylor's hypothesis, transform the time series to a spatial field $u(x)$ and plot an extract.
- Calculate the correlation function $C(r) = \langle u'(x+r)u'(x)\rangle$ of the fluctuations $u' = u - \langle u\rangle$ and plot it.
- Determine the integral length scales L by $L = \int_0^\infty \mathrm{d}r \frac{C(r)}{C(0)}$ as well as by an exponential fit (by discarding a certain range of small r).
- Determine the Taylor length λ.
- Calculate the structure functions $S_n(r) = \langle [u(x+r) - u(x)]^n \rangle$ up to order 6 and plot them in a log-log-representation. How would a power-law behavior $S_n(r) \sim r^{\zeta_n}$ look like in such a representation.