Project #1: *A priori* study

Part I: Filtering the DNS data

On the DNS data given in HW#2 "HW#2-Materials.zip" or your own data, perform the following jobs:

1. Using a 3D box filter (in physical space) with the width $\Delta_i = n\ dx_i$ (n=2) in each direction, compute the filtered velocity filed. Then, compare the profiles of U_1, $\overline{U}_1$, $\overline{\overline{U}}_1$, $\langle U_1 \rangle$, and $\langle \overline{U}_1 \rangle$ on a single diagram. Compute the filtered filed with $\Delta_i = 4\ dx_i$ and add $\overline{U}_1$ with this filter to the diagram. Note: all instantaneous profiles should be plotted versus x_2 along a line passing the center of the domain ($x_1 = x_{1,max}/2, x_3 = x_{3,max}/2$).
2. Compute the field of the resolved part of the fluctuating velocities, $\bar{u}_1$ and $\bar{u}_2$, for the both filter widths. Then, compare the profiles of $\langle \bar{u}_1 \bar{u}_2 \rangle$ and $\langle u_1 u_2 \rangle$ versus x_2. What does this comparison mean?
3. Compute the field of the residual stress tensor, τ_{12}^R, for the both filter widths. Then, compare the profiles of $\langle \tau_{12}^R \rangle$ and $\langle u_1 u_2 \rangle$ versus x_2. What does this comparison mean?
4. Compute the field of $\bar{S}_{ij}$ (simplify the components if applicable) and plot $\langle \bar{S}_{12} \rangle$ versus x_2. Did you expect this result?