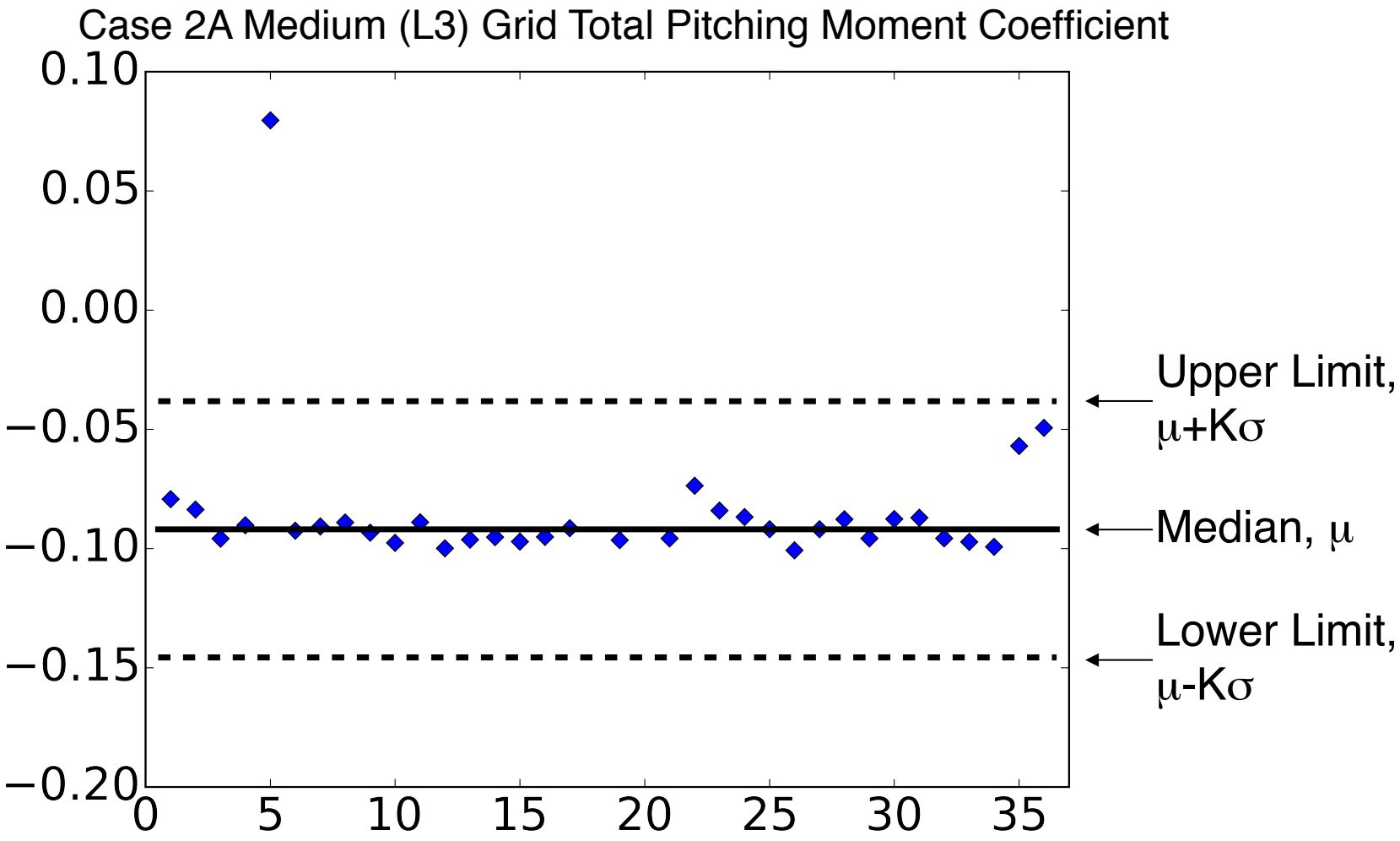
Preliminary Statistical Analysis of CFD Solutions

Joseph Derlaga,

Joseph Morrison,

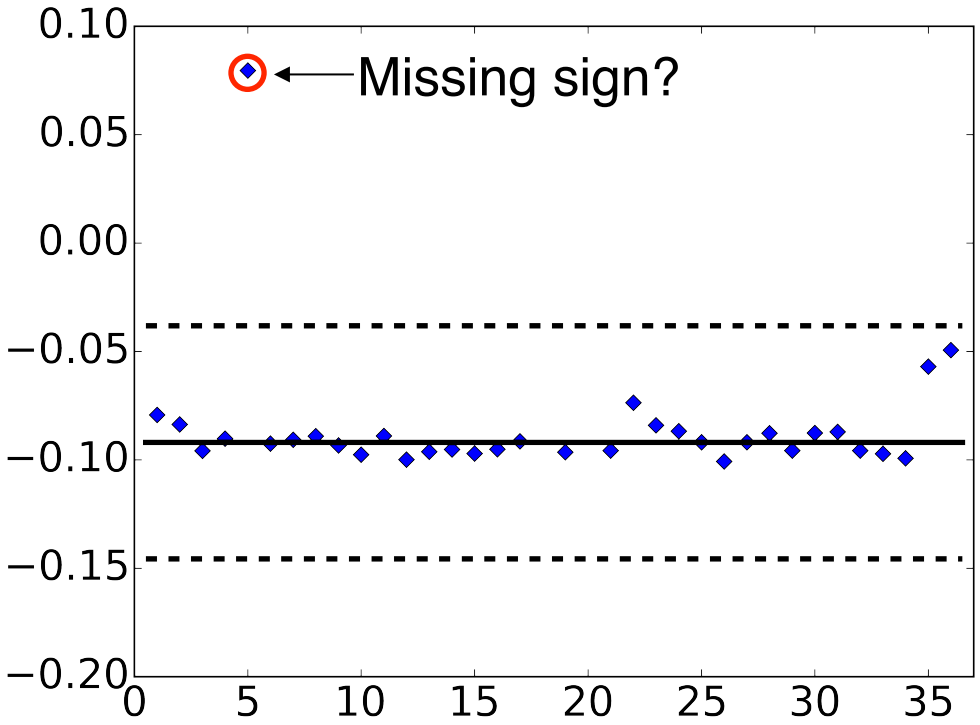
and the DPW Organizing Committee

Analysis Method



The median gives a robust estimate of the population mean.

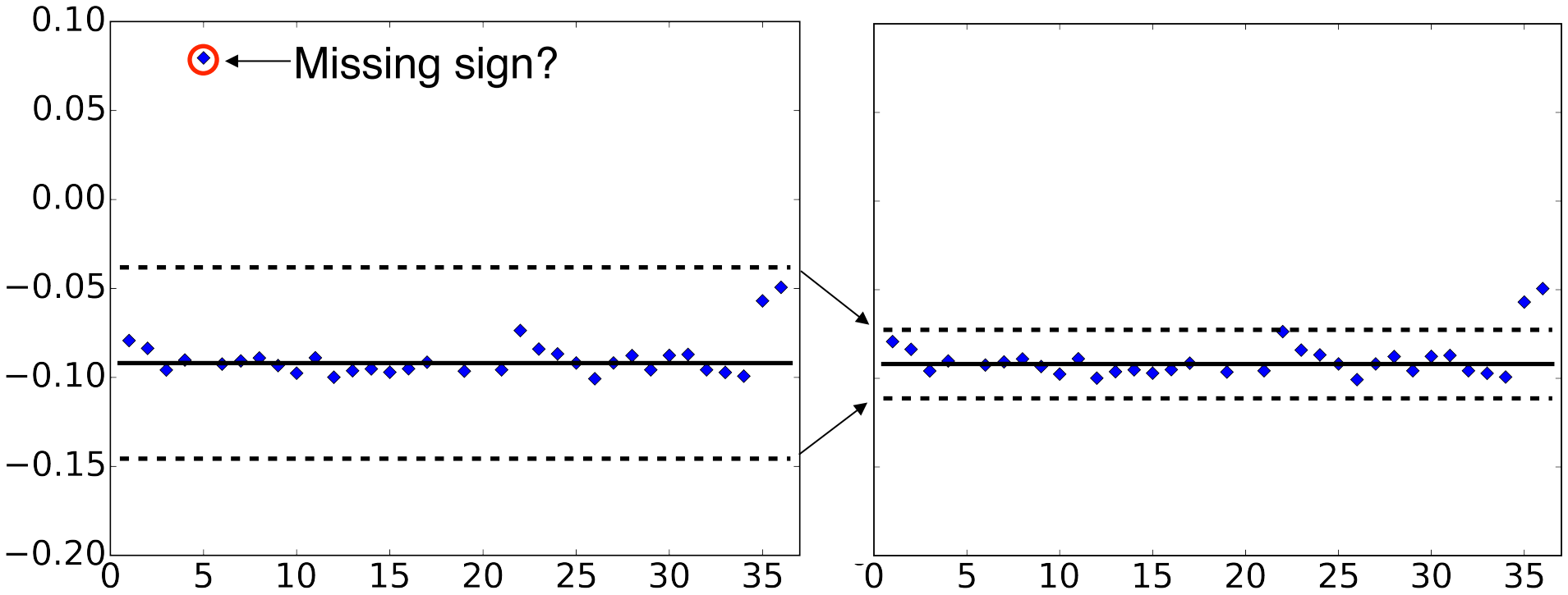
Case 2A Medium (L3) Grid
Total Pitching Moment Coefficient



6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2A Medium (L3) Grid
Total Pitching Moment Coefficient

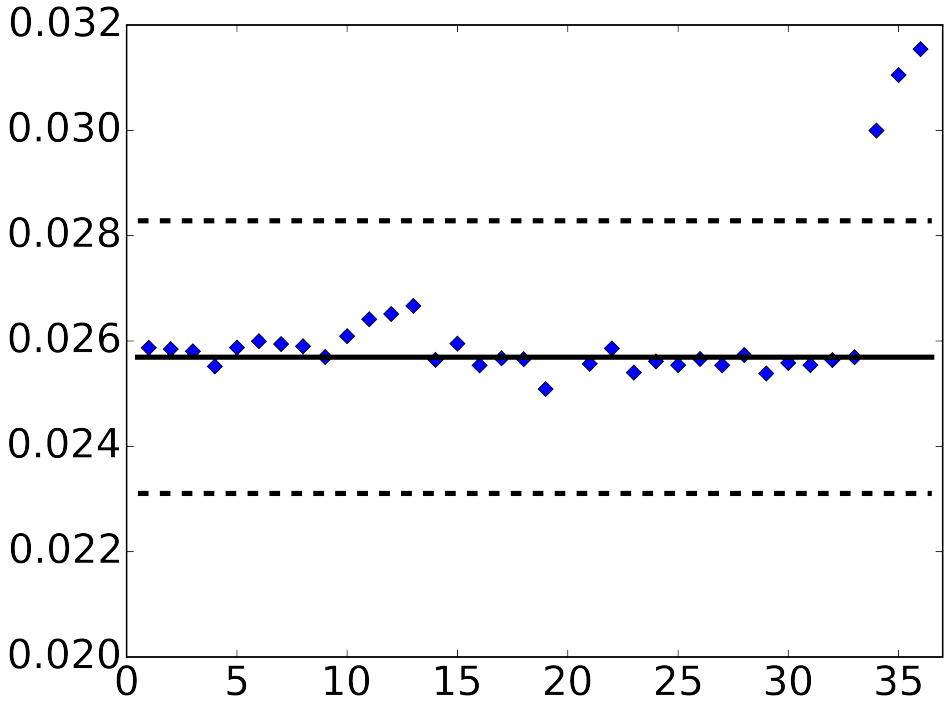


NB: Same vertical axis range!

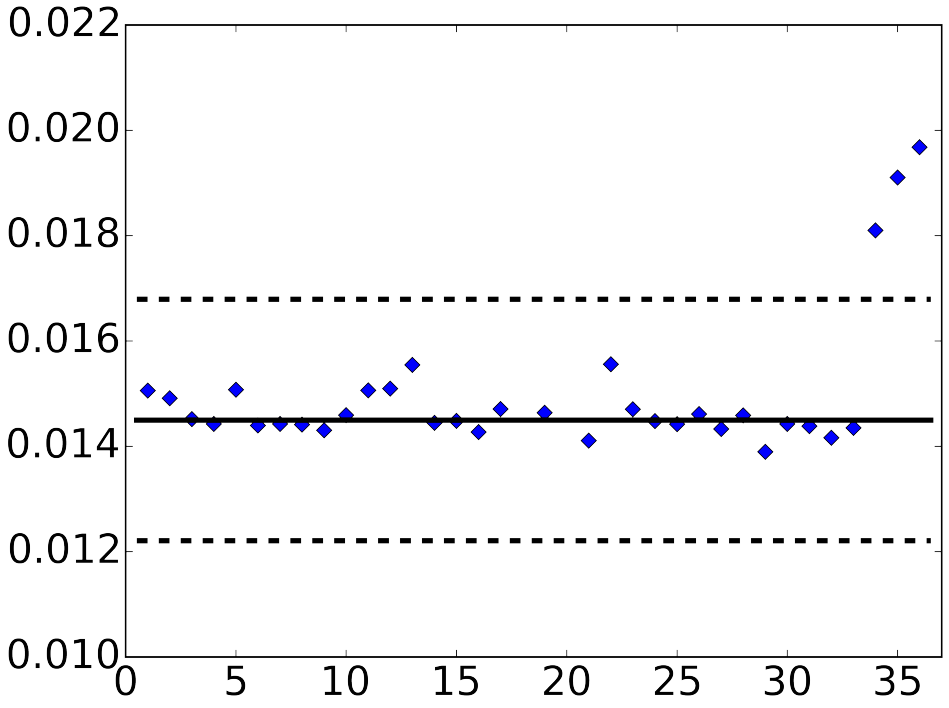
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2A Medium (L3) Grid
Total Drag Coefficient



Case 2A Medium (L3) Grid
Pressure Drag Coefficient

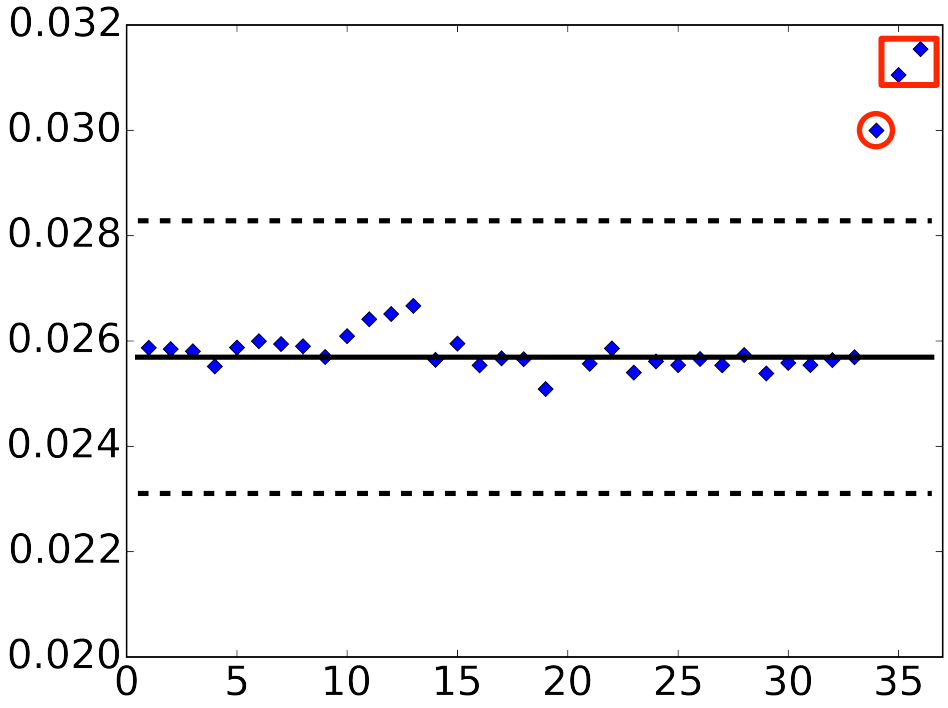


NB: Same vertical axis scale,
but different range!

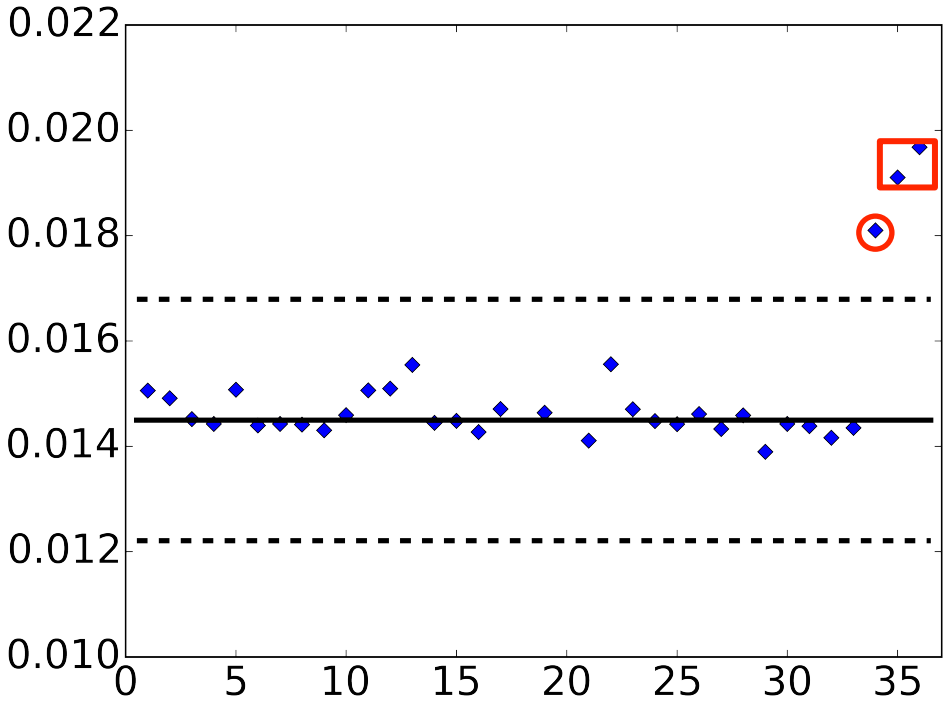
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2A Medium (L3) Grid
Total Drag Coefficient



Case 2A Medium (L3) Grid
Pressure Drag Coefficient

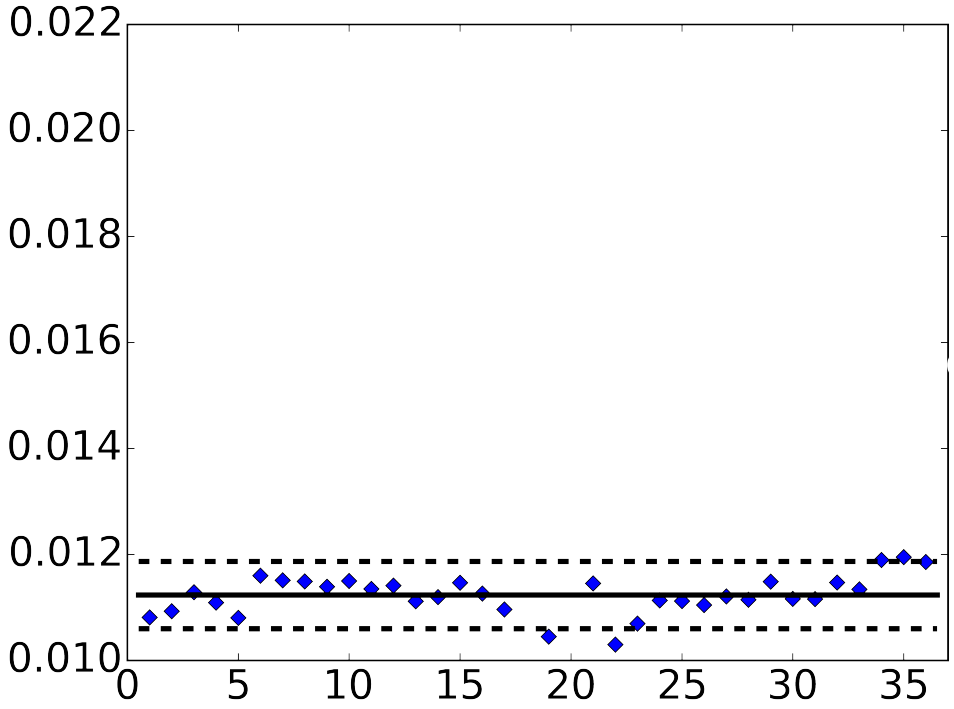


Corrected data to achieve $C_L = 0.5$
Very coarse grids (L5 is ~L1 recommended); distinct turbulence model

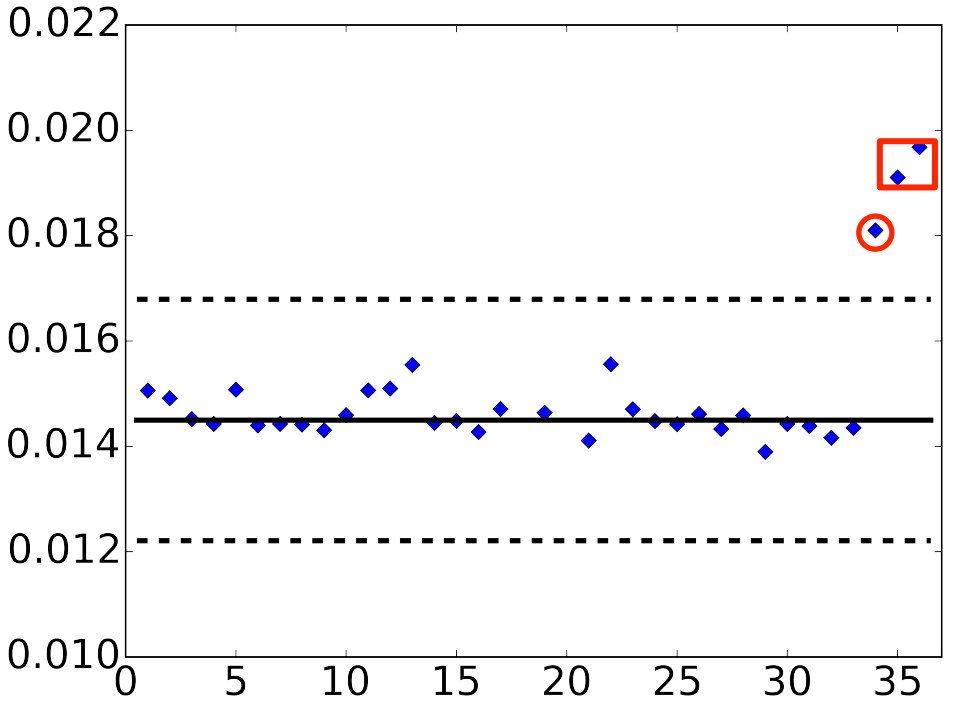
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2A Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2A Medium (L3) Grid
Pressure Drag Coefficient

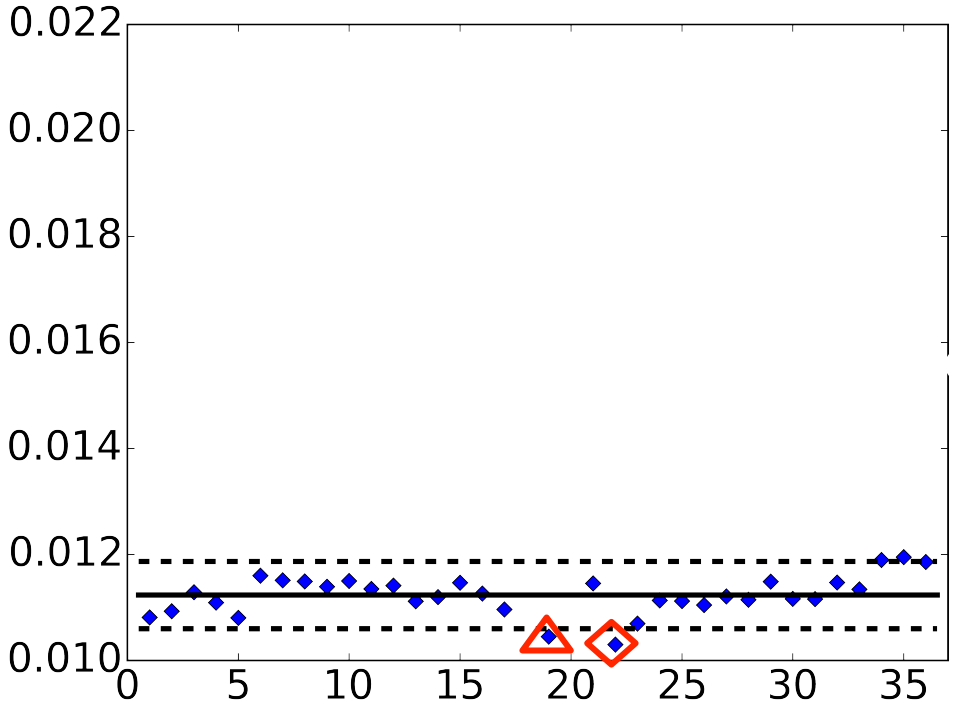


NB: Same vertical axis range!

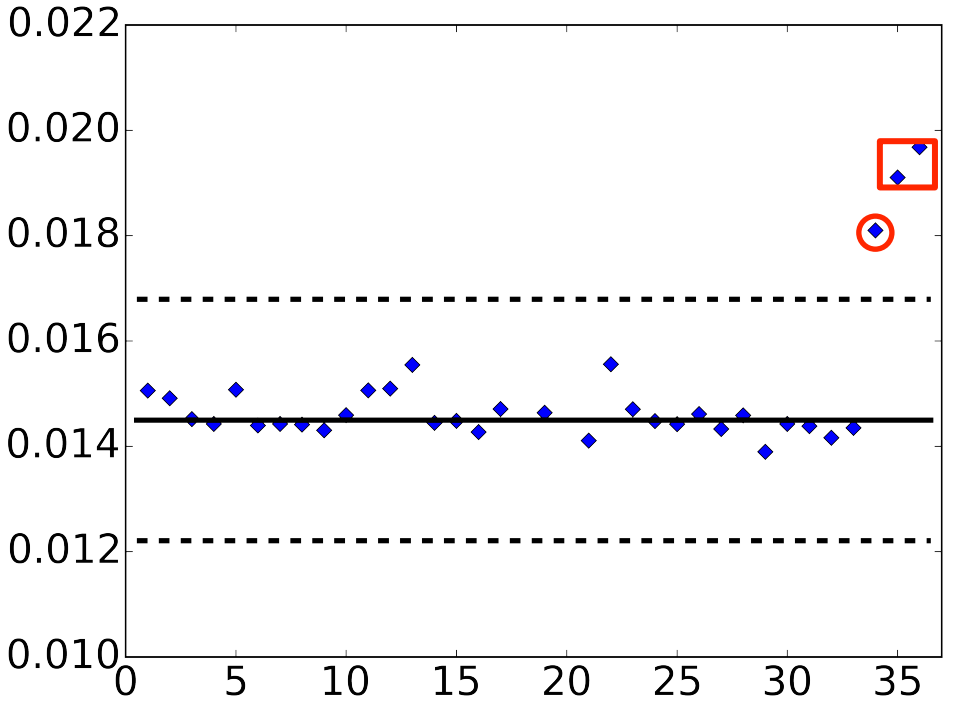
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2A Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2A Medium (L3) Grid
Pressure Drag Coefficient

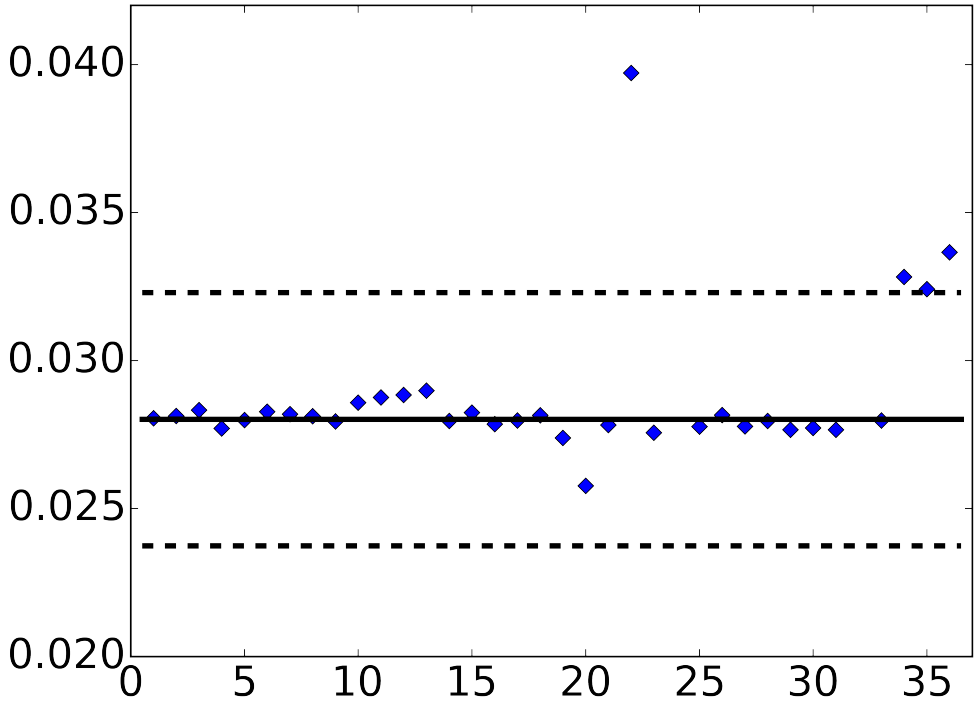


△ ◇ Only low on L2 and L3,
but tend to be the lowest values on L4 and L5

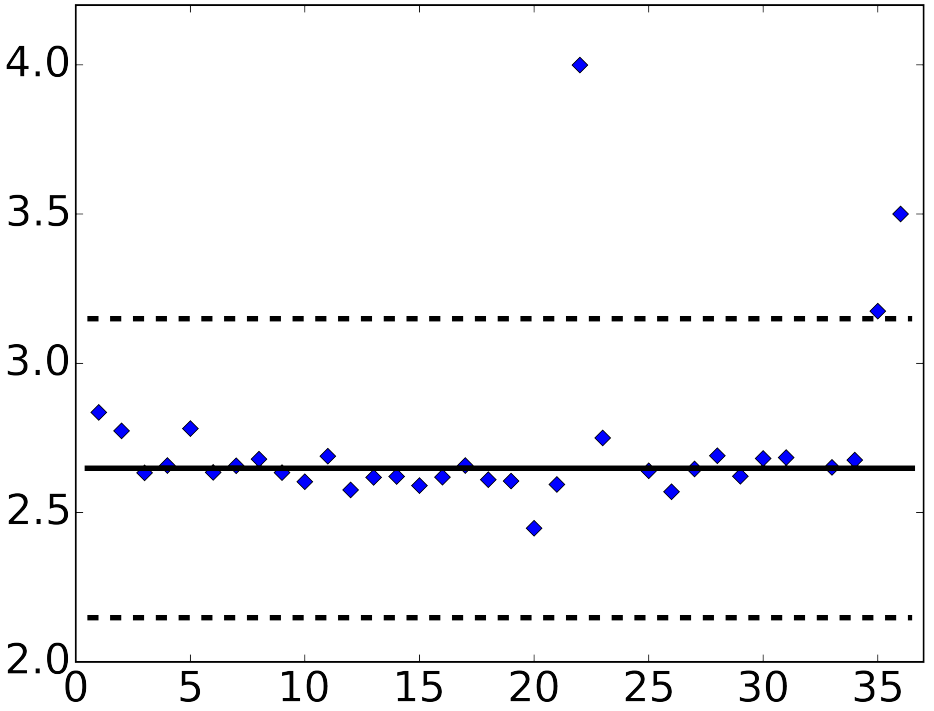
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Total Drag Coefficient



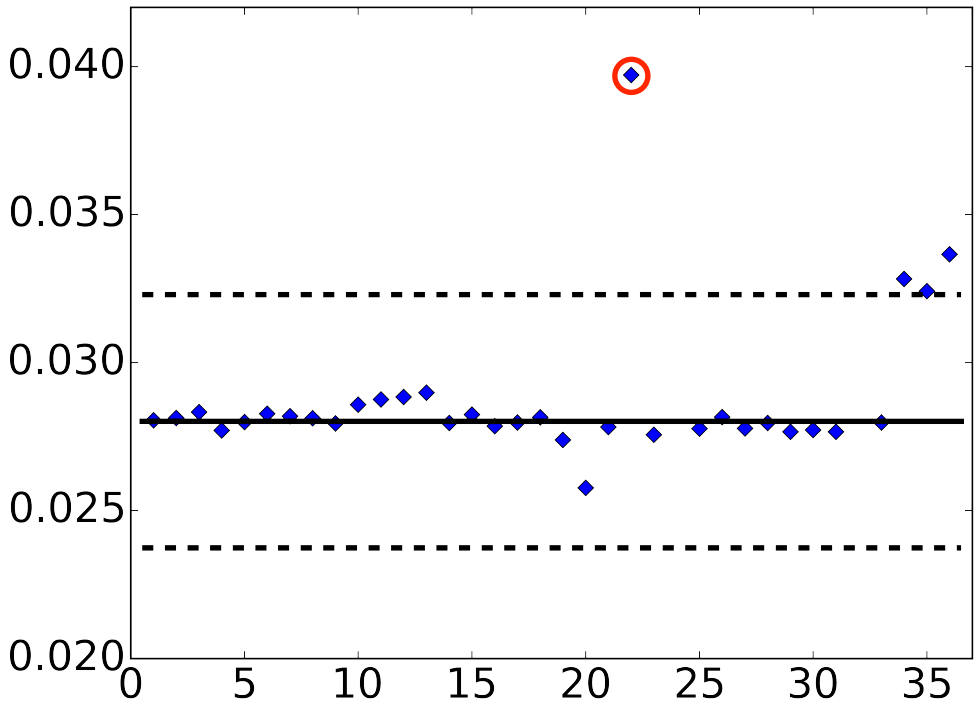
Case 2B Medium (L3) Grid
Angle of Attack



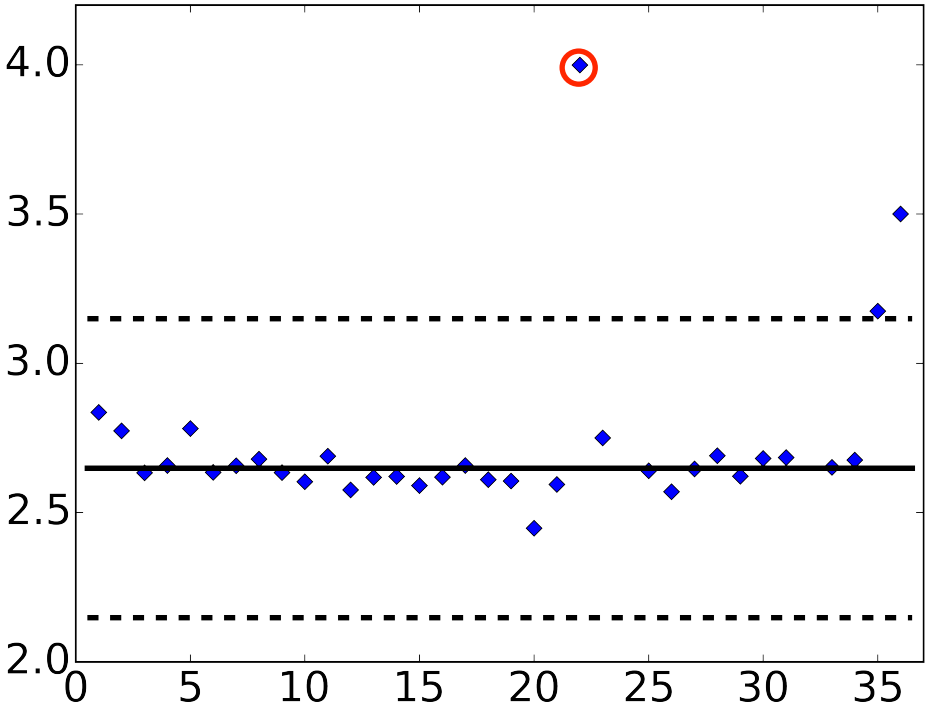
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Total Drag Coefficient



Case 2B Medium (L3) Grid
Angle of Attack

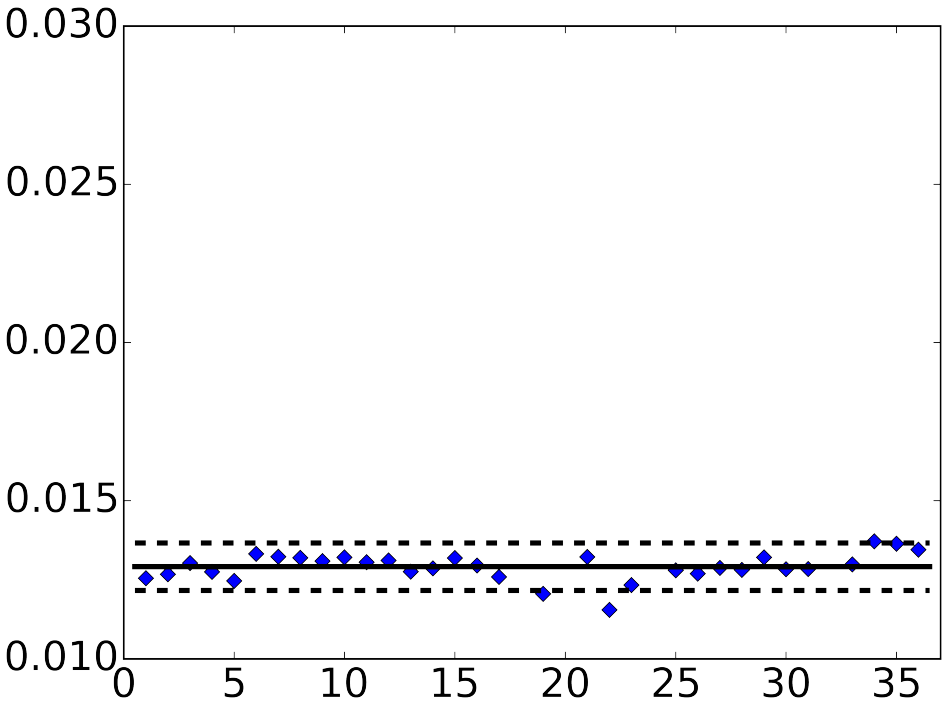


Same code, turbulence model, and grid as other submissions… we need more info

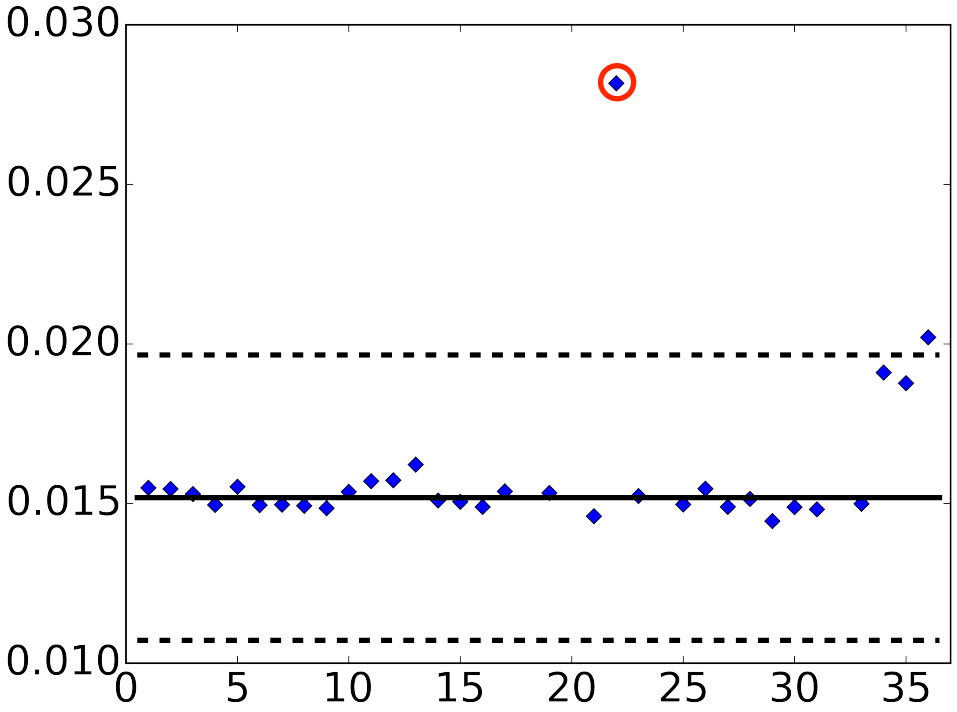
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2B Medium (L3) Grid
Pressure Drag Coefficient

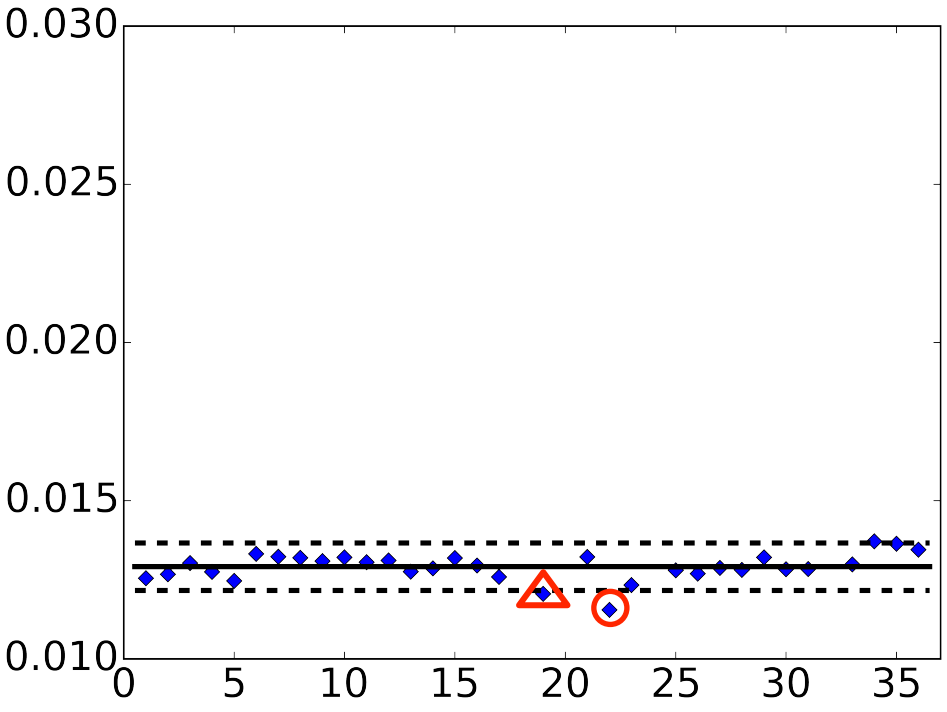


NB: Same vertical axis range!

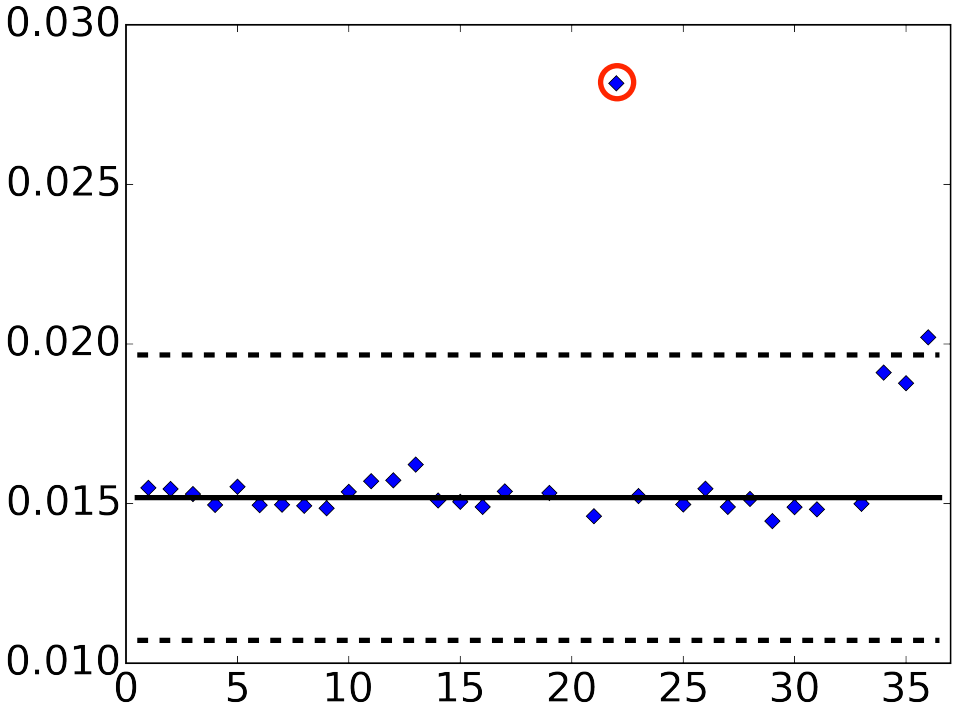
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2B Medium (L3) Grid
Pressure Drag Coefficient

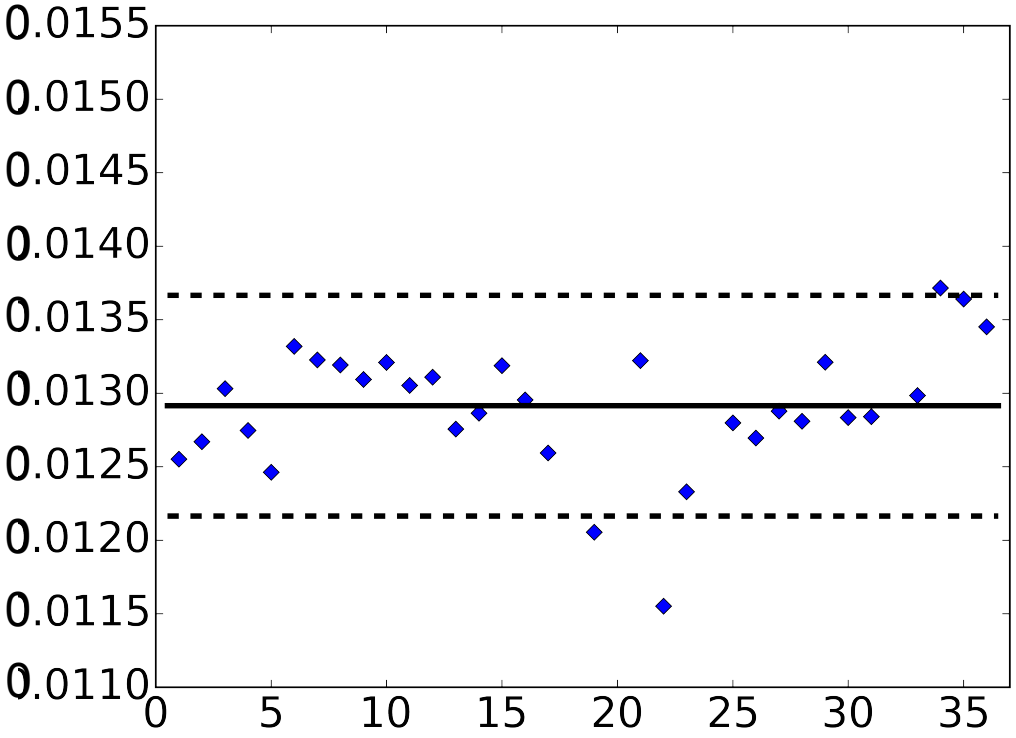


△ Only low on L2 and L3,
but tend to be the lowest values on L4 and L5

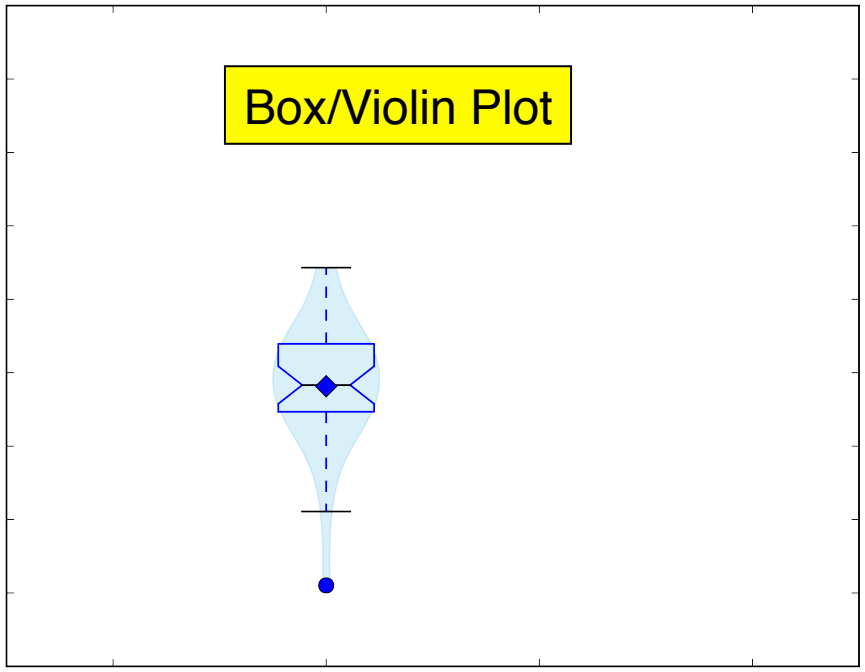
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient

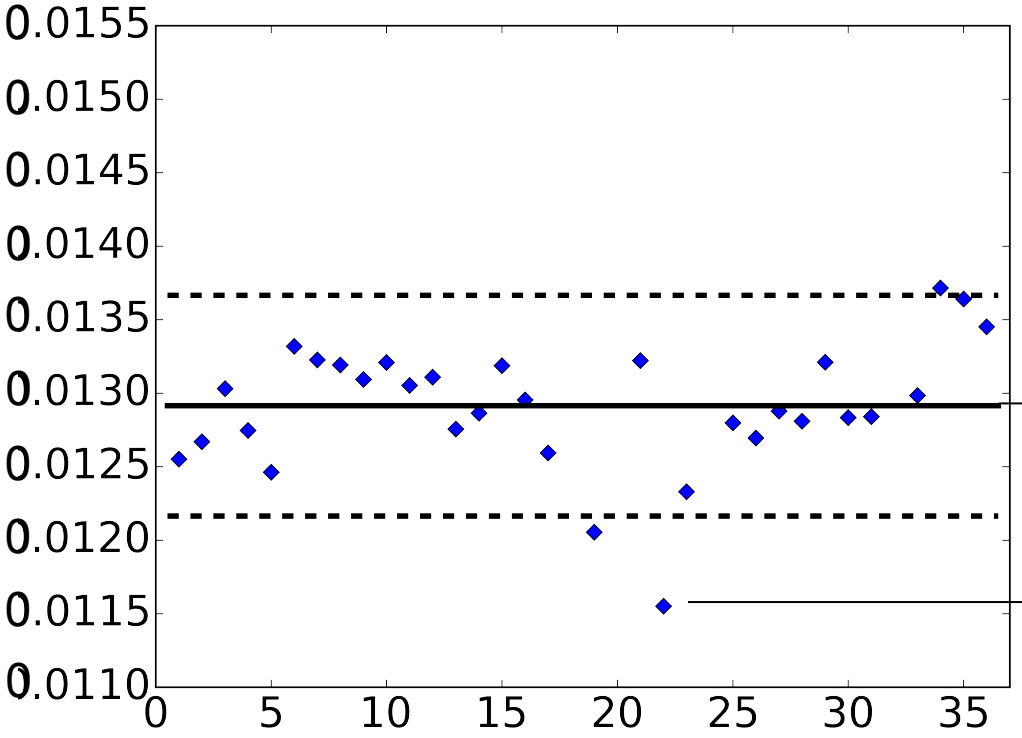


NB: Same vertical axis range!

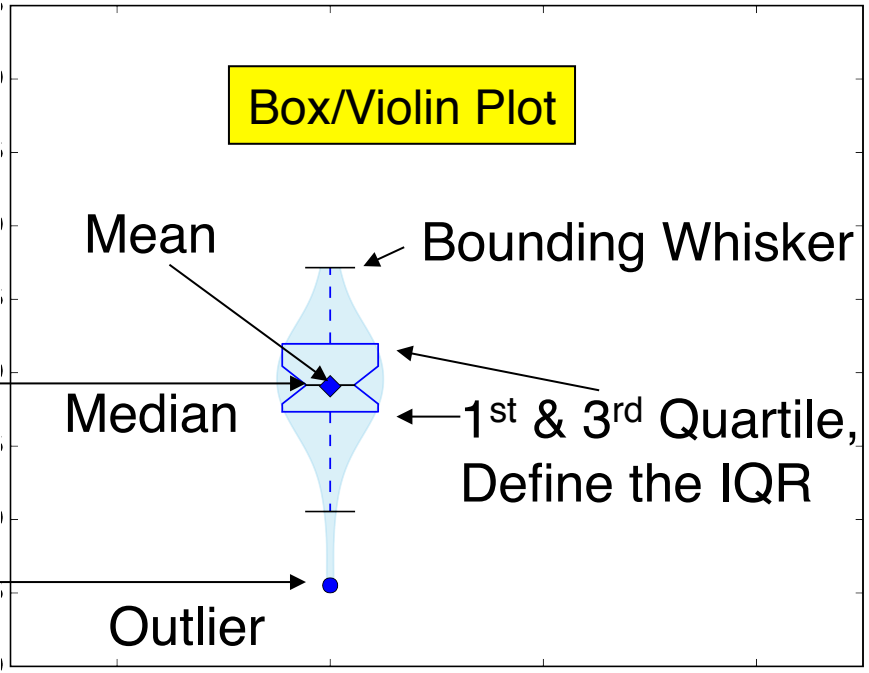
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient

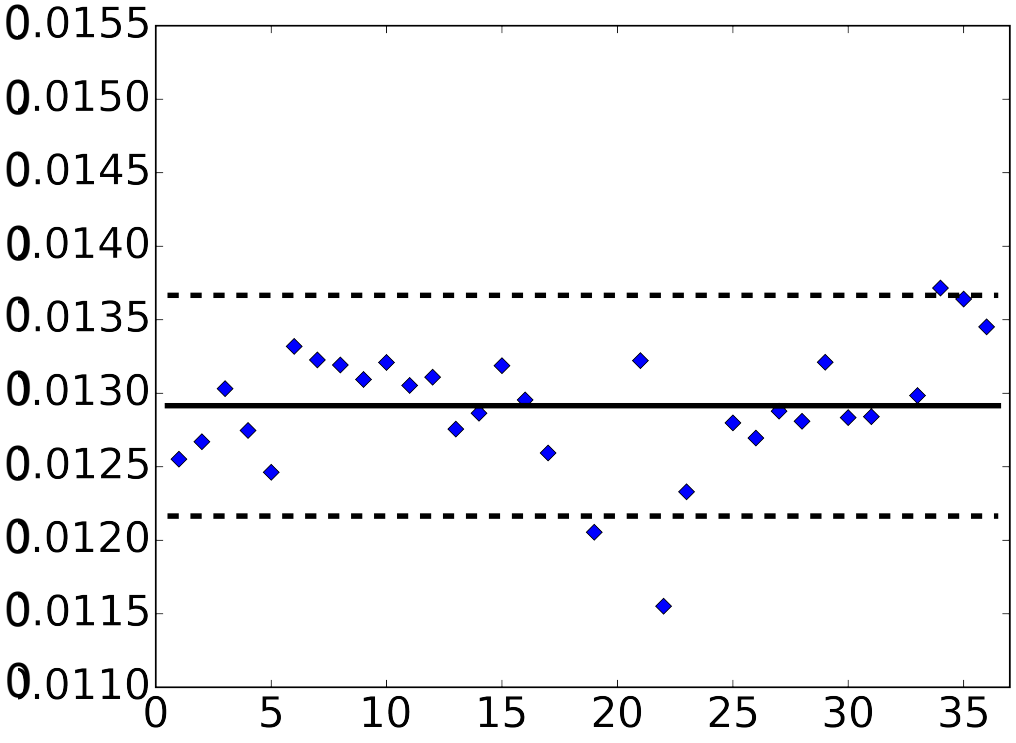


Blue shading is probability density function (PDF)

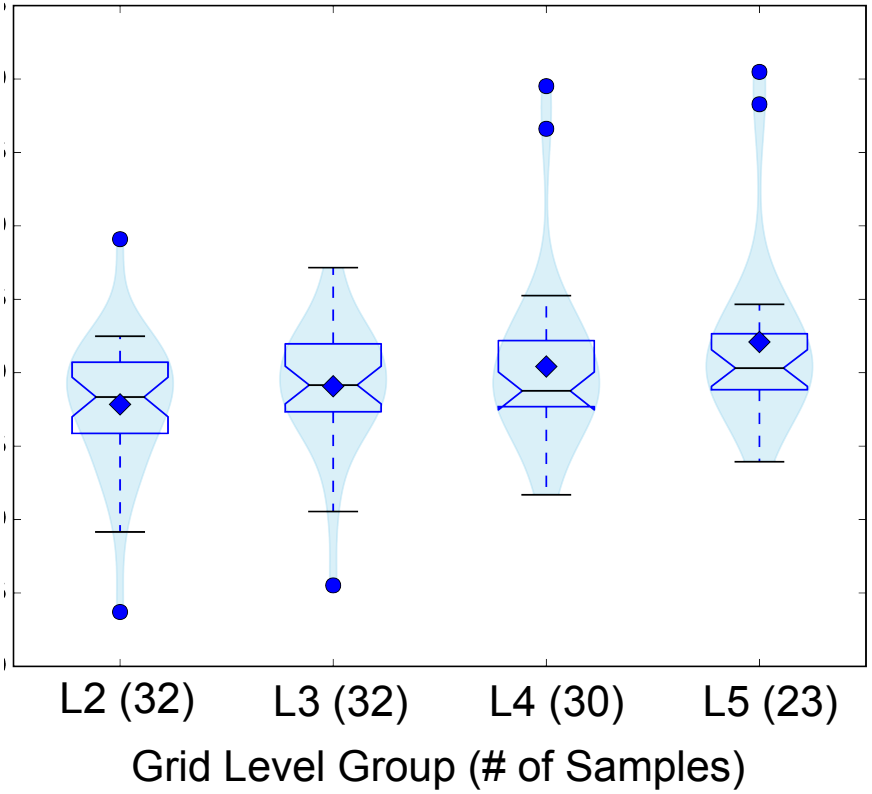
6th CFD Drag Prediction Workshop

Washington D.C. – June 2016

Case 2B Medium (L3) Grid
Skin Friction Drag Coefficient



Case 2B L2 - L5 Grids
Skin Friction Drag Coefficient



Concluding Remarks

- Much less spread in C_{Dsf} compared to C_{Dpr}
- Double check signs on reported values
- Double check if reported grid levels match required (L2-L5) grid levels