

Validation and Use of PANS for Vehicle Aerodynamics and Active Flow Control

G. Minelli, B. Basara, S. Krajnović

minelli@chalmers.se



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15%



70%

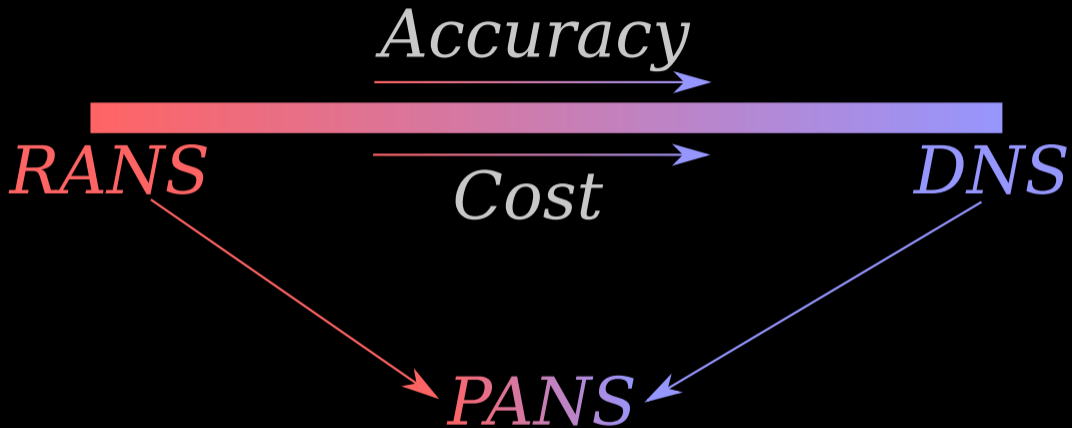


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$$f_k = \frac{1}{\sqrt{C_\mu}} \left(\frac{\Delta}{\Lambda} \right)^{\frac{2}{3}} > \frac{k_u}{k}$$

$$\sqrt[3]{\Delta_x \Delta_y \Delta_z}$$

$$\frac{k^{3/2}}{\epsilon}$$

$$f_k = \frac{1}{\sqrt{C_\mu}} \left(\frac{\Delta}{\Lambda} \right)^{\frac{2}{3}} > \frac{\kappa u}{k}$$

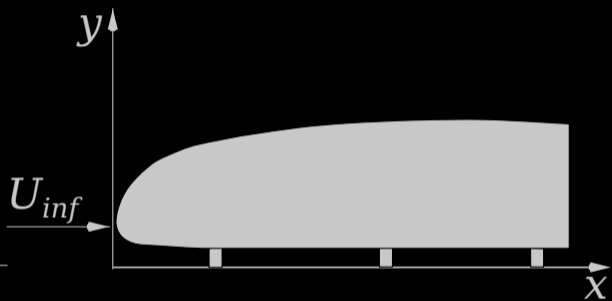
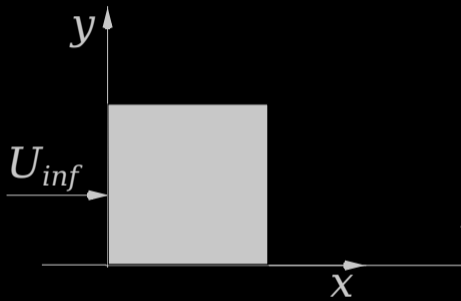
$\sqrt[3]{\Delta_x \Delta_y \Delta_z}$

$\frac{k^{3/2}}{\varepsilon}$

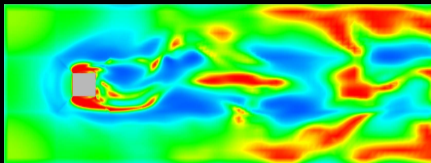
$$f_k = \frac{1}{\sqrt{C_\mu}} \left(\frac{\Delta}{\Lambda} \right)^{\frac{2}{3}} > \frac{\kappa_u}{k}$$

$\sqrt[3]{\Delta_x \Delta_y \Delta_z}$

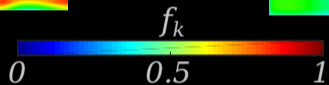
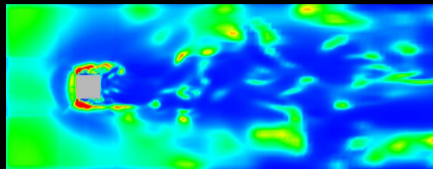
$\frac{k^{3/2}}{\varepsilon}$



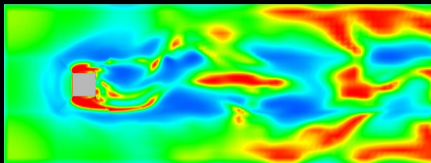
Coarse grid



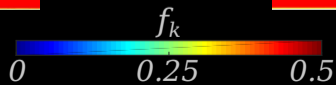
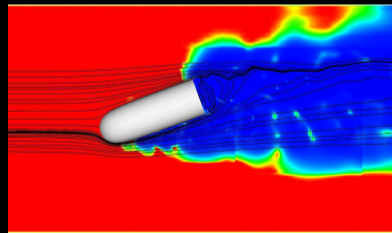
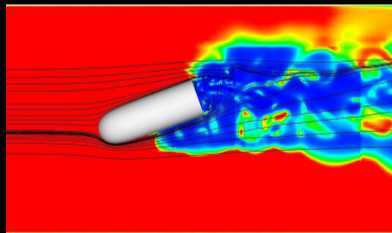
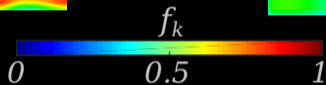
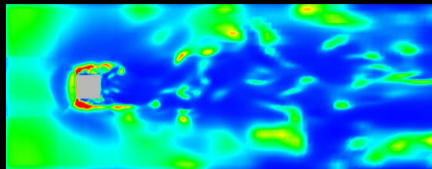
Fine grid



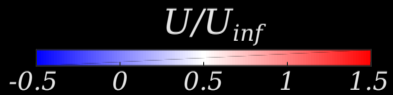
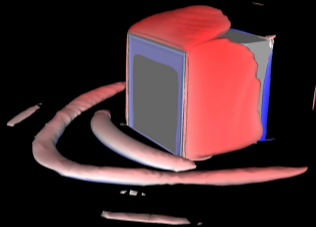
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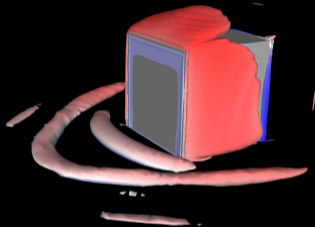
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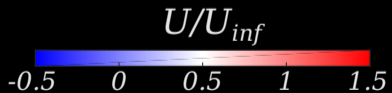
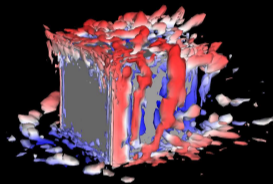
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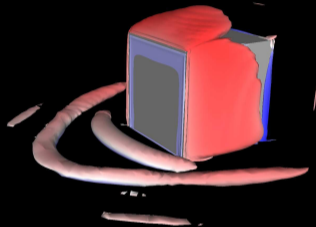
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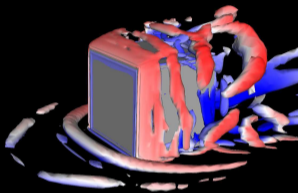
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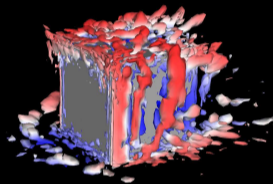
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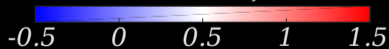
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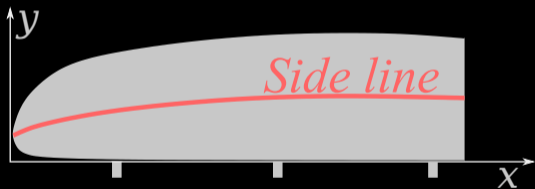
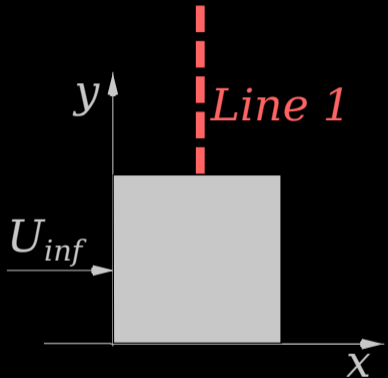


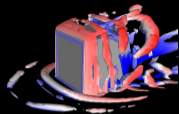
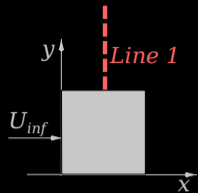
LES



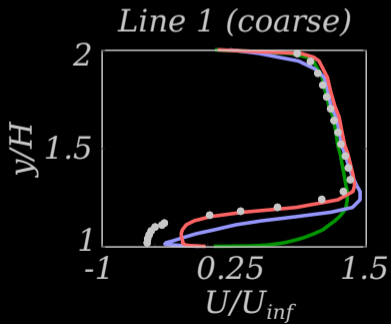
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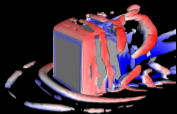
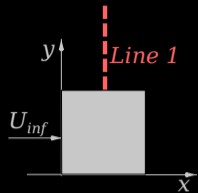




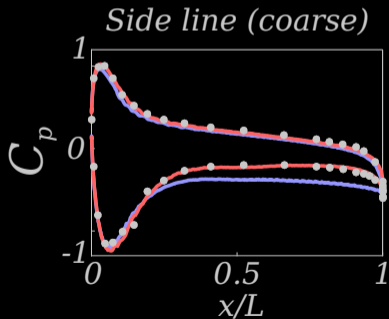
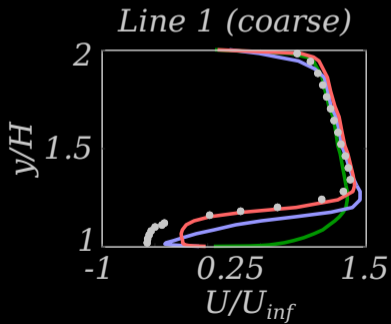
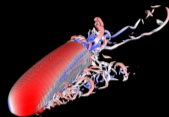
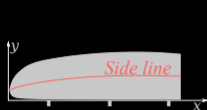


- • *Exp*
- *URANS*
- *PANS*
- *LES*





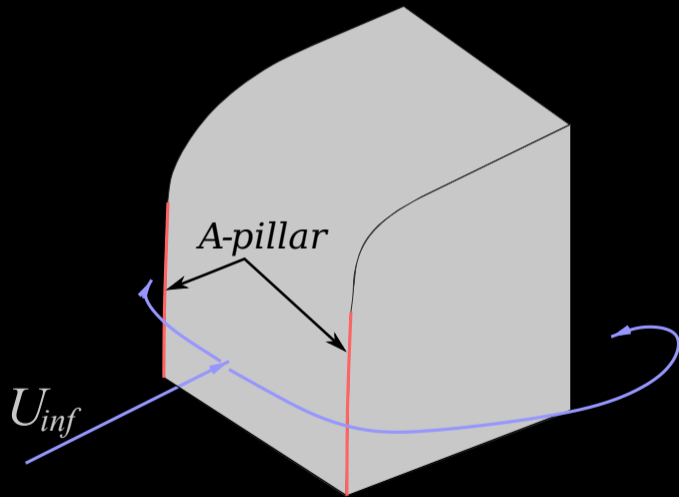
- • *Exp*
- *URANS*
- *PANS*
- *LES*

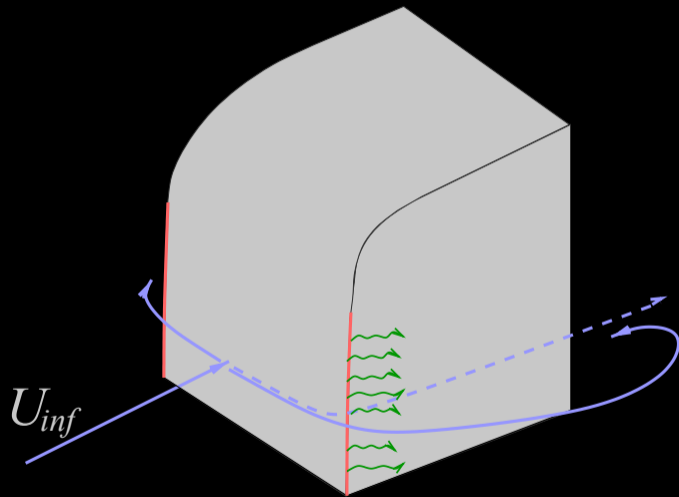


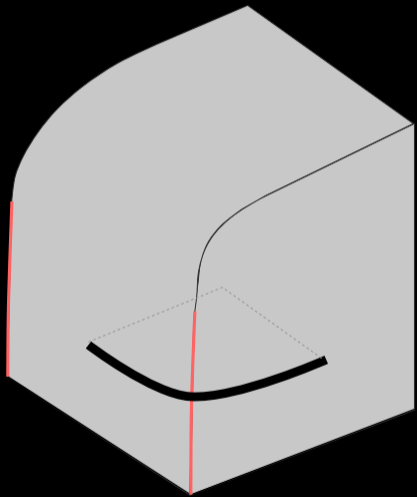


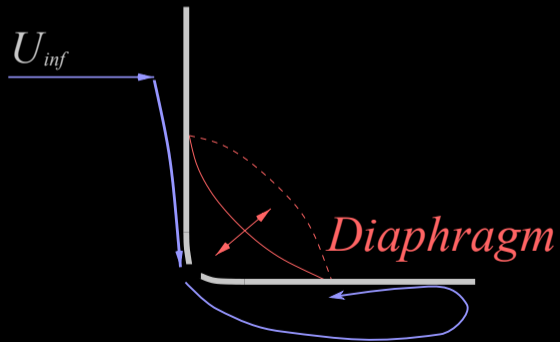
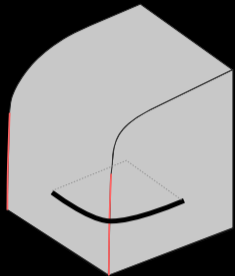


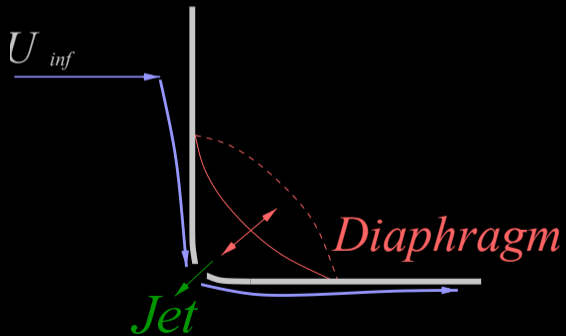
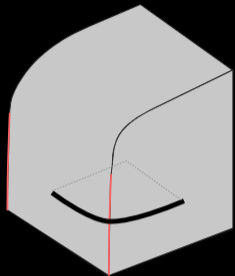
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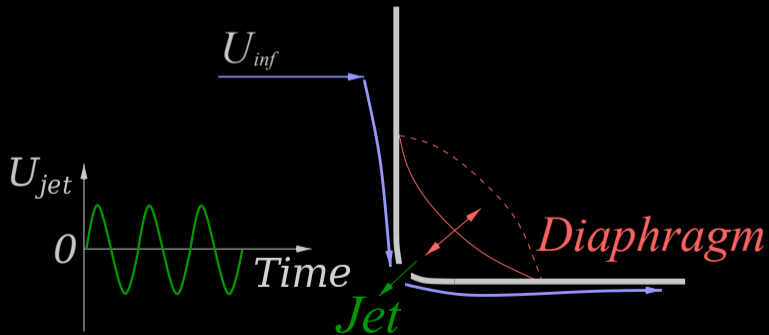
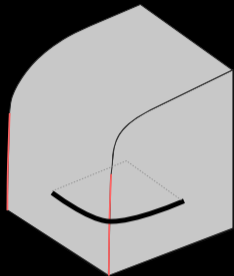


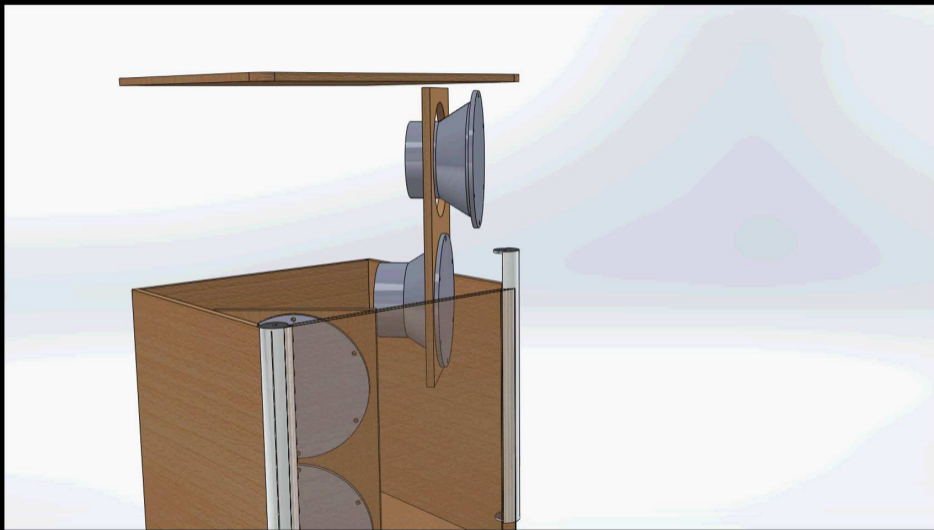


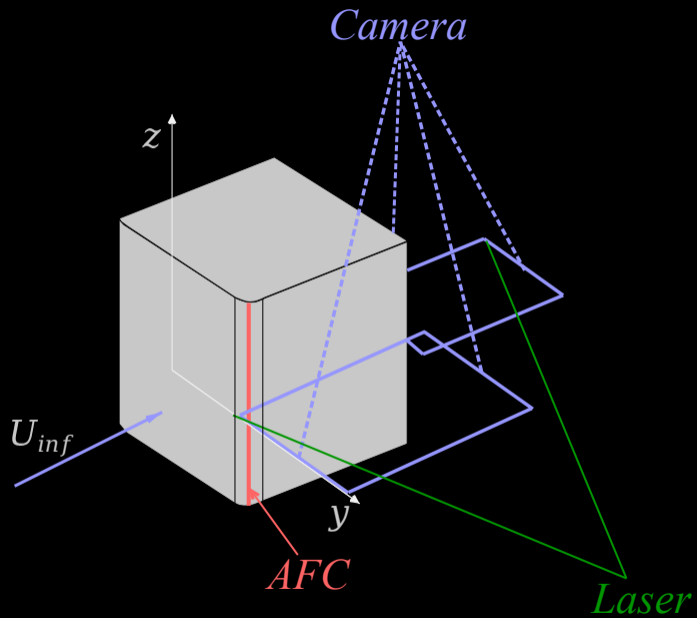


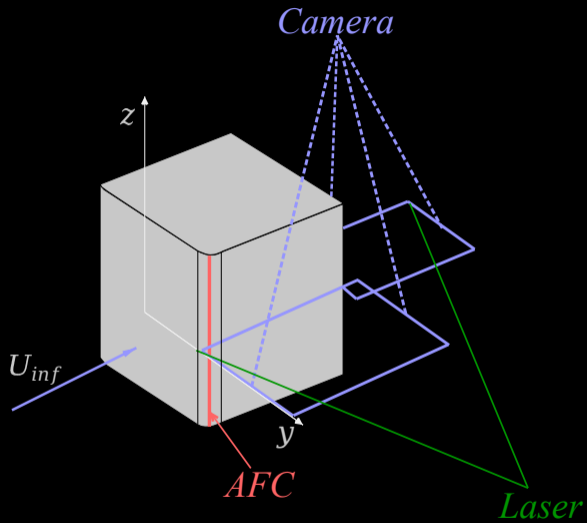




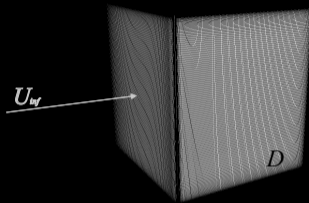




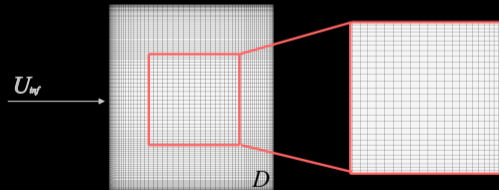
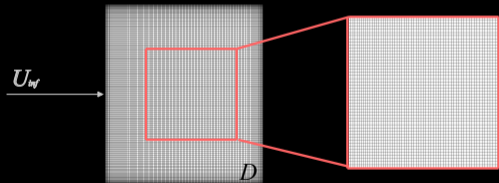
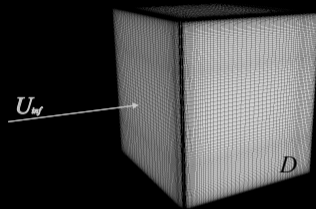


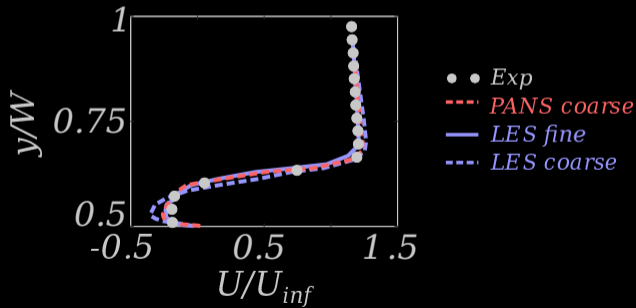
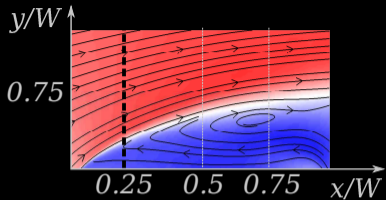
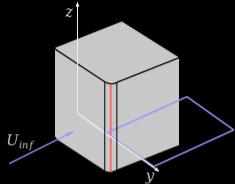


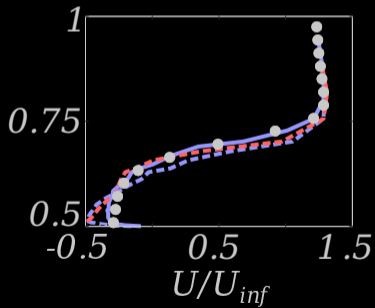
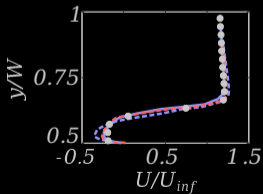
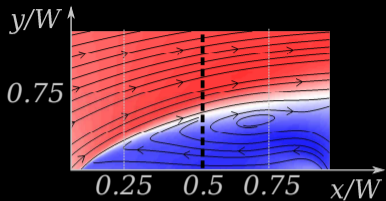
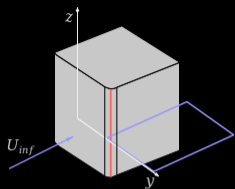
Fine (16 mil)

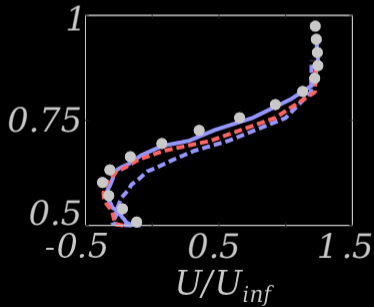
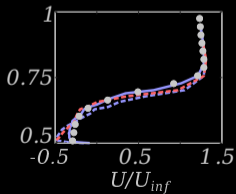
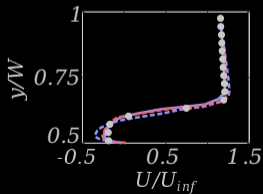
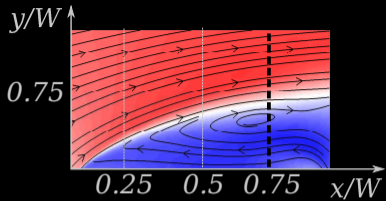
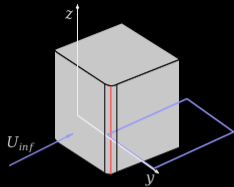


Coarse (4 mil)

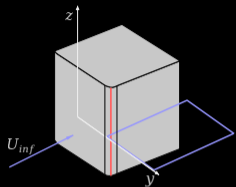






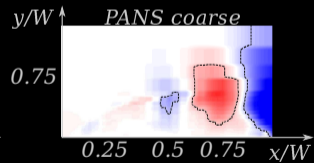
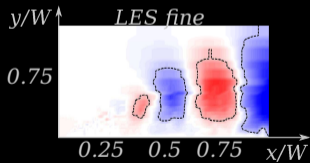
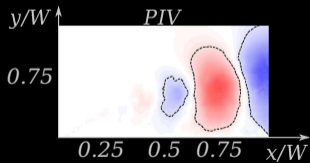


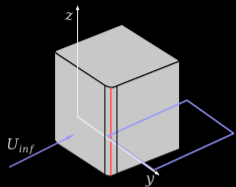
- ● Exp
- PANS coarse
- LES fine
- LES coarse



v component (y)

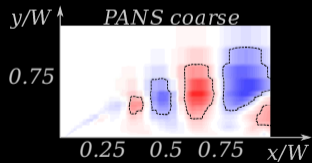
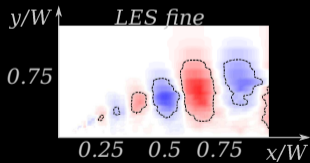
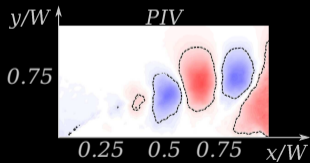
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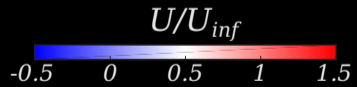


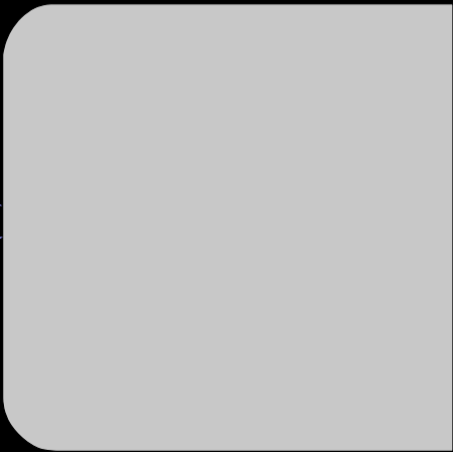
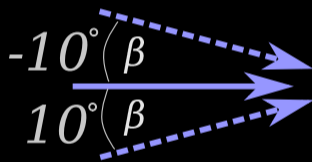


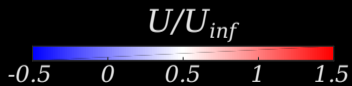
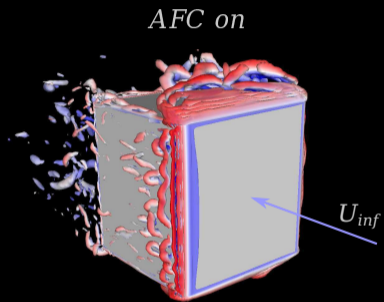
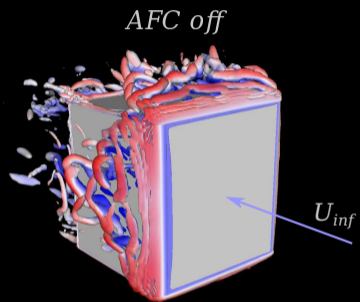
v component (y)

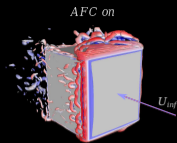
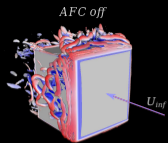
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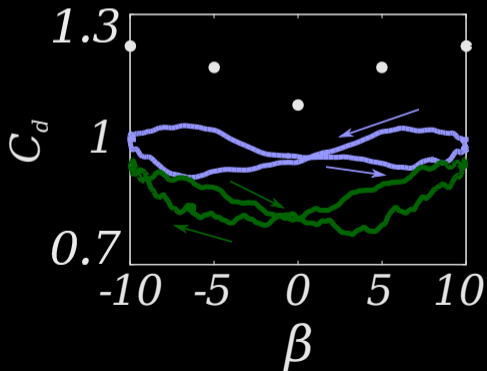


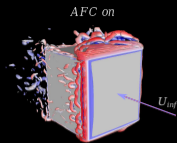
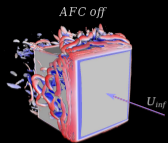




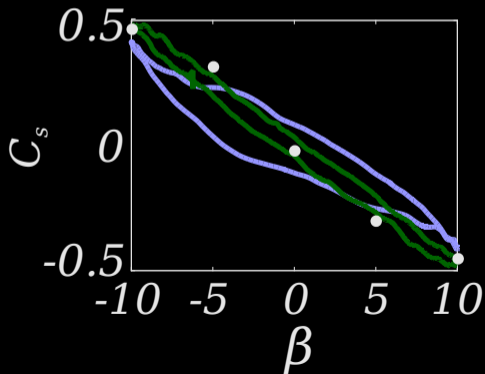
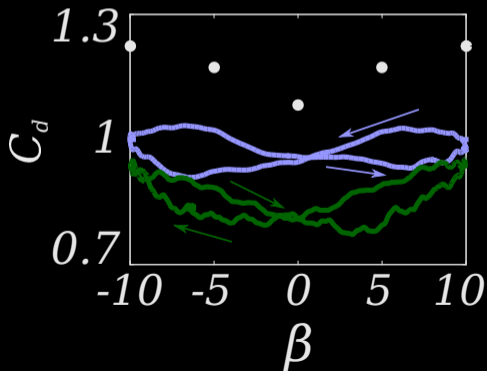


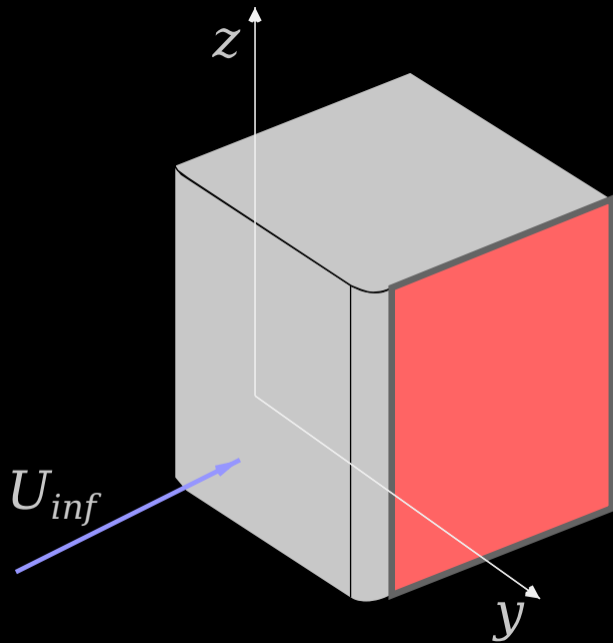
•• *Stat* — *Dyn* — *Dyn Actuated*

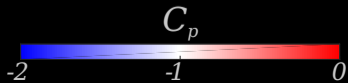
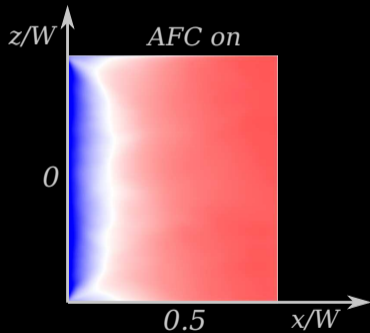
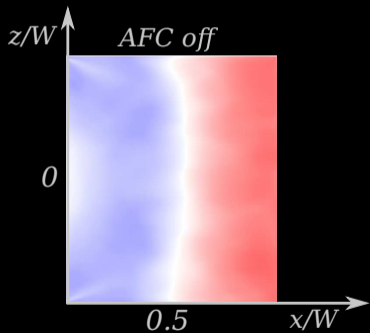
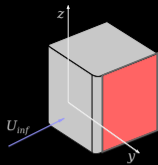




•• Stat — Dyn — Dyn Actuated









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