Problem definition

A Study of the Effect of Curvature on Fully Developed Turbulent Flows

Section to simulate
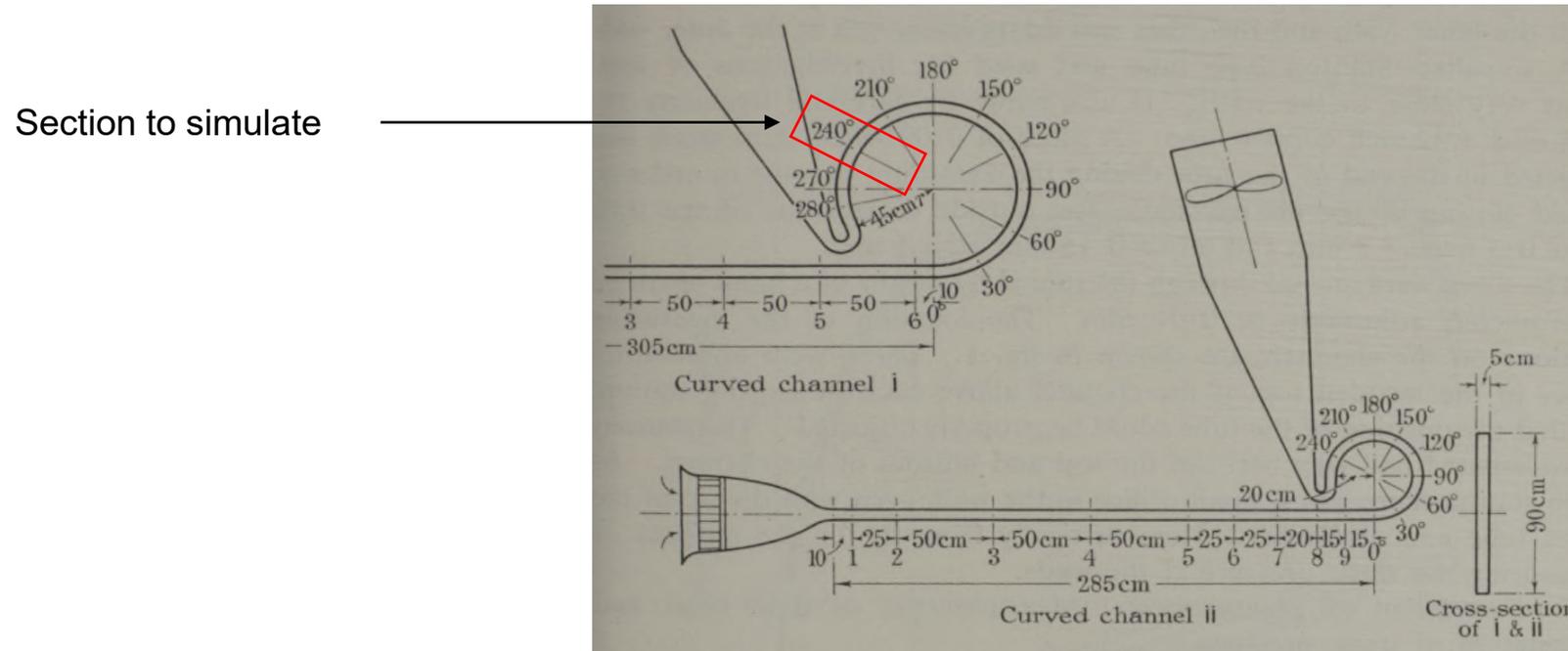
Curved channel (From Ref. 1).

- This validation case corresponds to the numerical study of the effect of curvature on fully developed turbulent flows.
- The effect of the curvature of the channel leads to an anisotropic effect on the turbulent field.
- To correct the deficiency of EVM due to system curvature, we need to enable curvature corrections..
- **A few references:**
  - F. Wattendorf. A Study of the Effect of Curvature on Fully Developed Turbulent Flows. PhD Thesis, California Institute of Technology, US. June, 1934.

Problem definition

Geometry and mesh

Top wall

Section to simulate →

Periodic boundary conditions

Periodic boundary conditions

Bottom wall
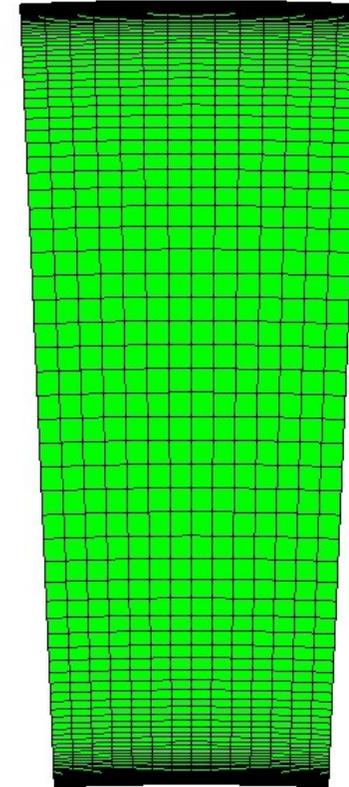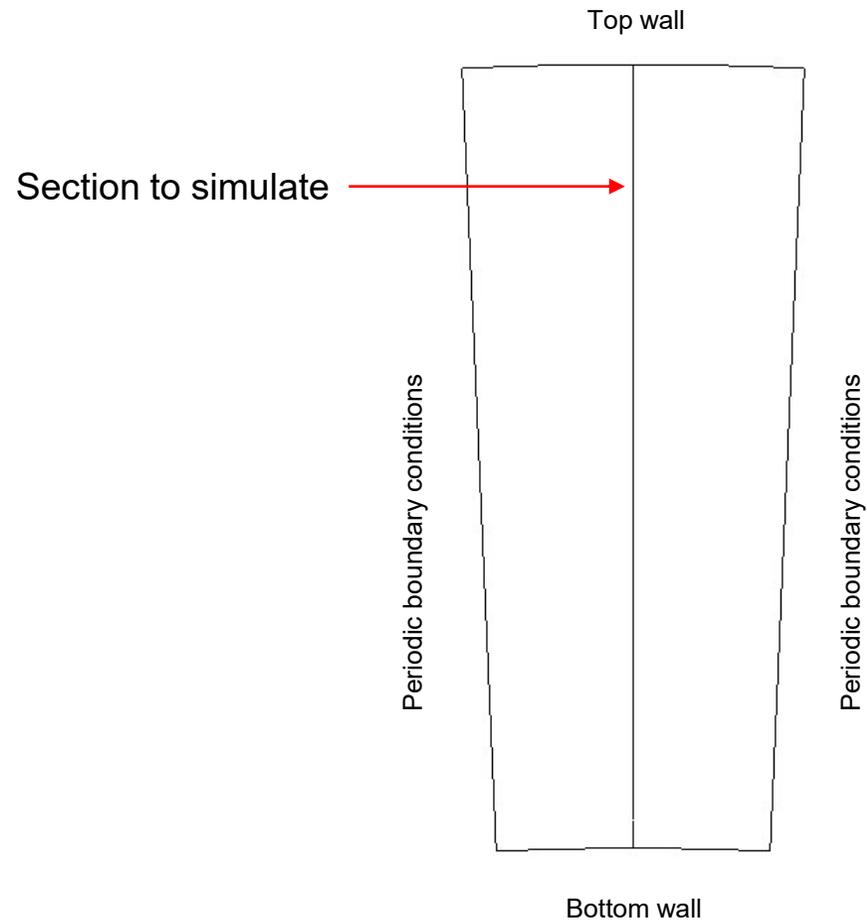
- This is a wall modeling mesh.

Qualitative and quantitative results

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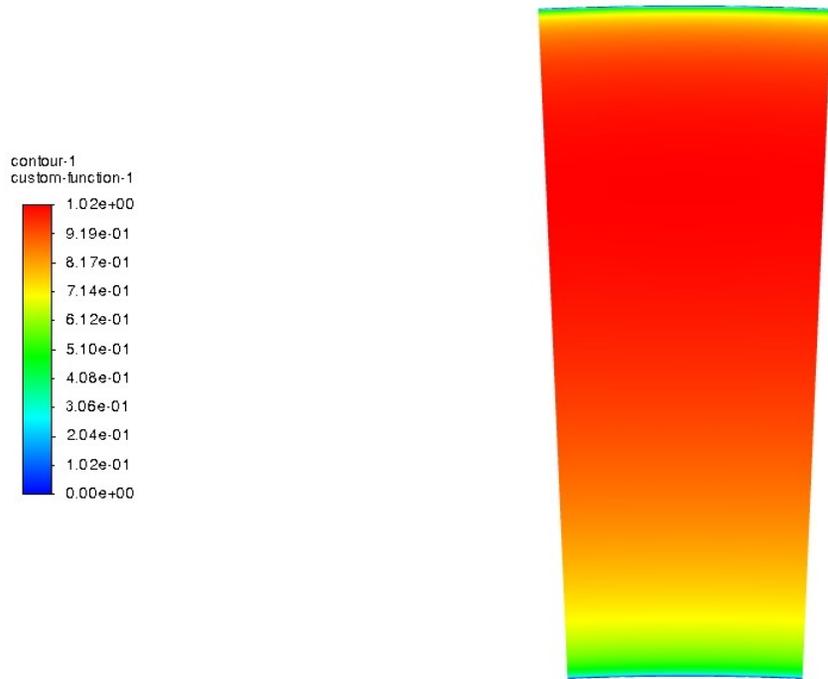
Contours of non-dimensional velocity
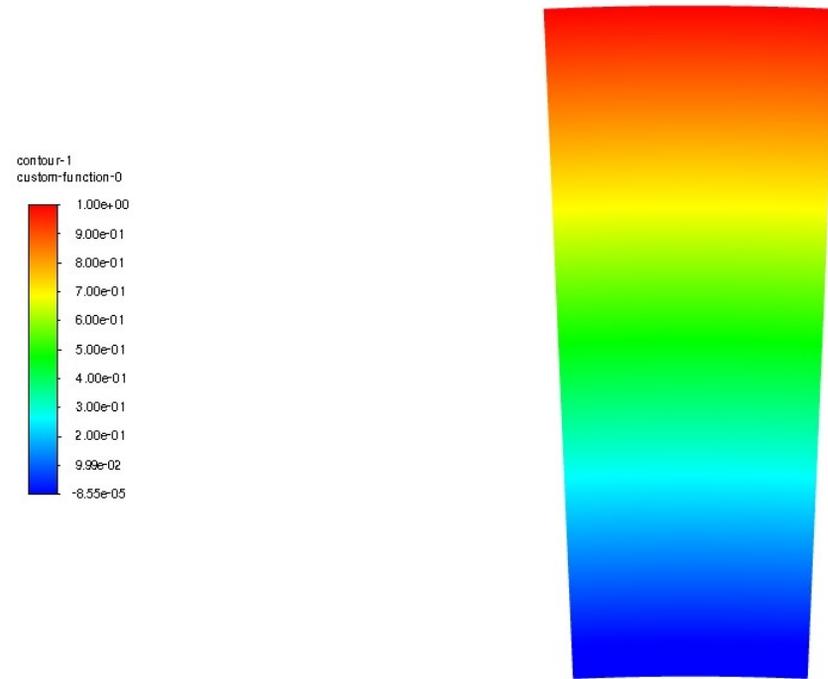
$$\frac{v_x y}{\bar{v}_x 0.25}$$

Mass weighted average ⟶

Contours of non-dimensional radial distance

$$\frac{\sqrt{x^2 + y^2}}{0.25 - 0.2}$$

External radius ⟶ ⟵ Internal radius

Qualitative and quantitative results

A Study of the Effect of Curvature on Fully Developed Turbulent Flows
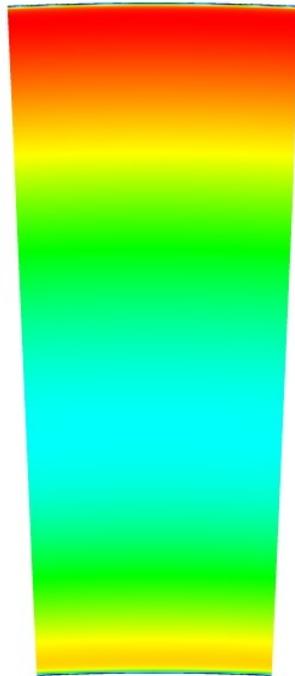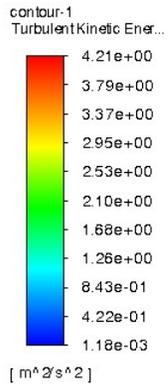

Contours of TKE – Curvature correction disabled
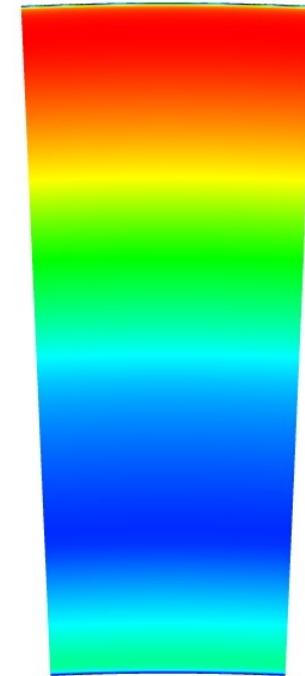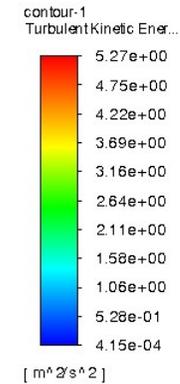
Contours of TKE – Curvature correction enabled

- K-Omega SST Turbulence model.

Qualitative and quantitative results

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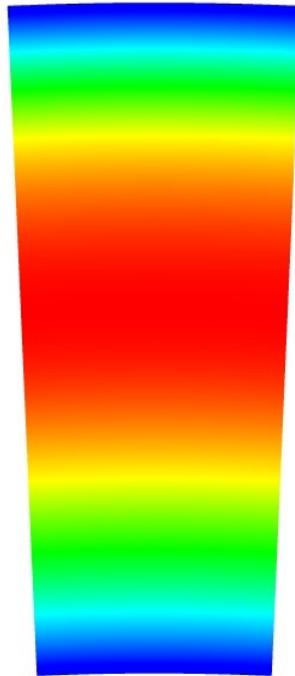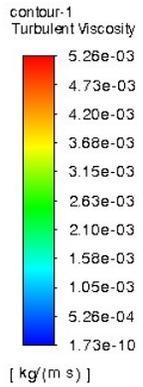

Contours of NUT – Curvature correction disabled
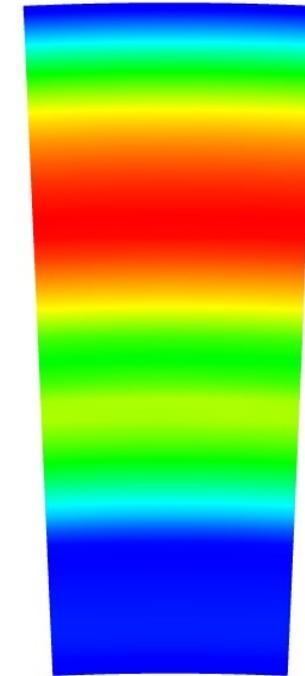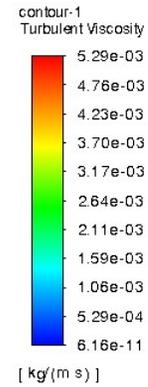
Contours of NUT – Curvature correction enabled

- K-Omega SST Turbulence model.

Qualitative and quantitative results

A Study of the Effect of Curvature on Fully Developed Turbulent Flows
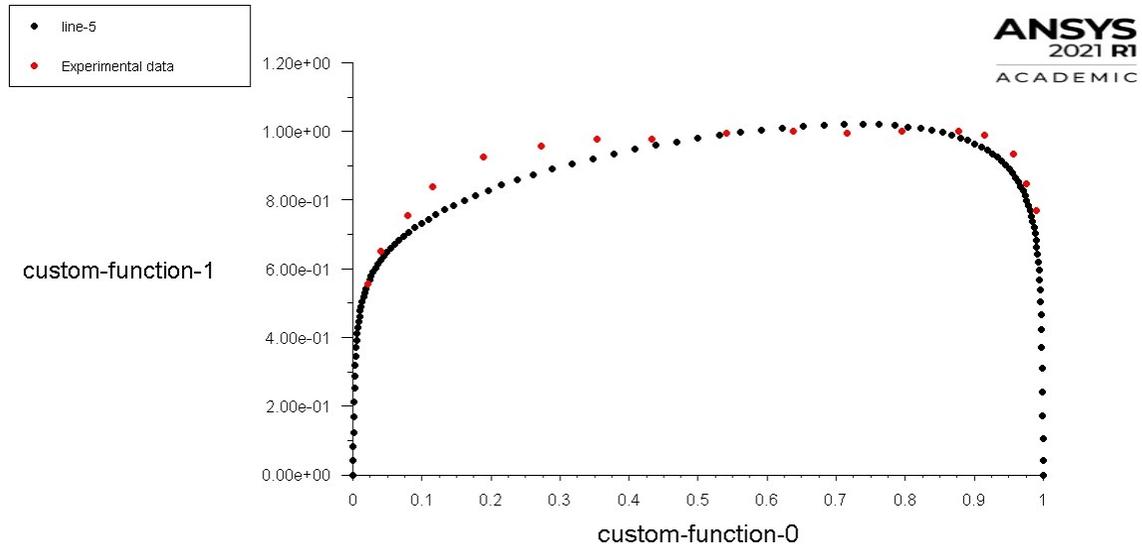

Curvature correction disabled
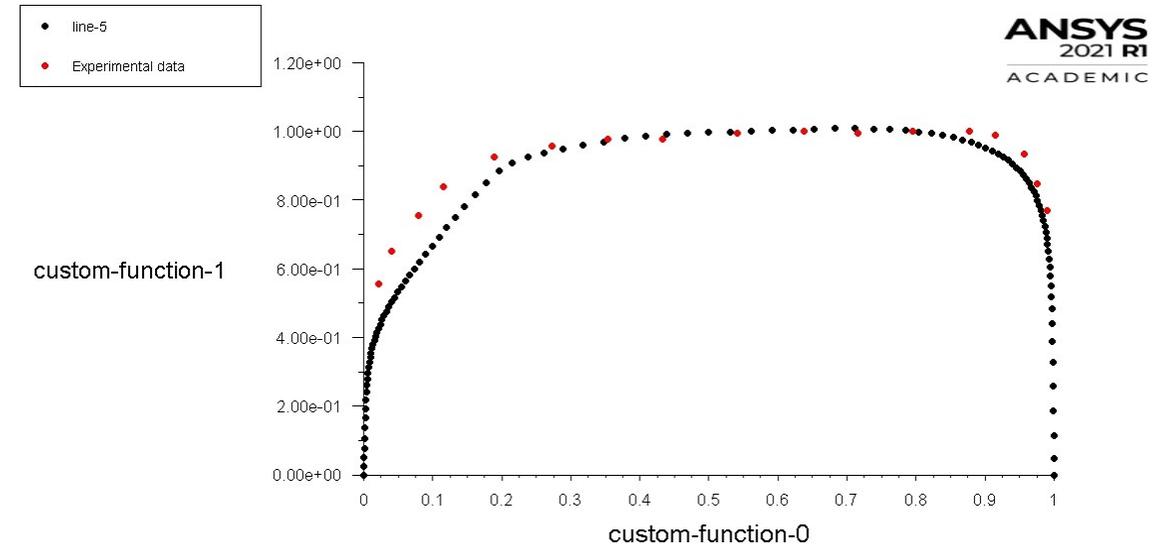
Curvature correction enabled – Correction coefficient = 1

- Plots of non-dimensional velocity in function of the non-dimensional radial distance.
- The curvature correction limiter corrects deficiencies of EVM models due to system curvature.

Qualitative and quantitative results

A Study of the Effect of Curvature on Fully Developed Turbulent Flows
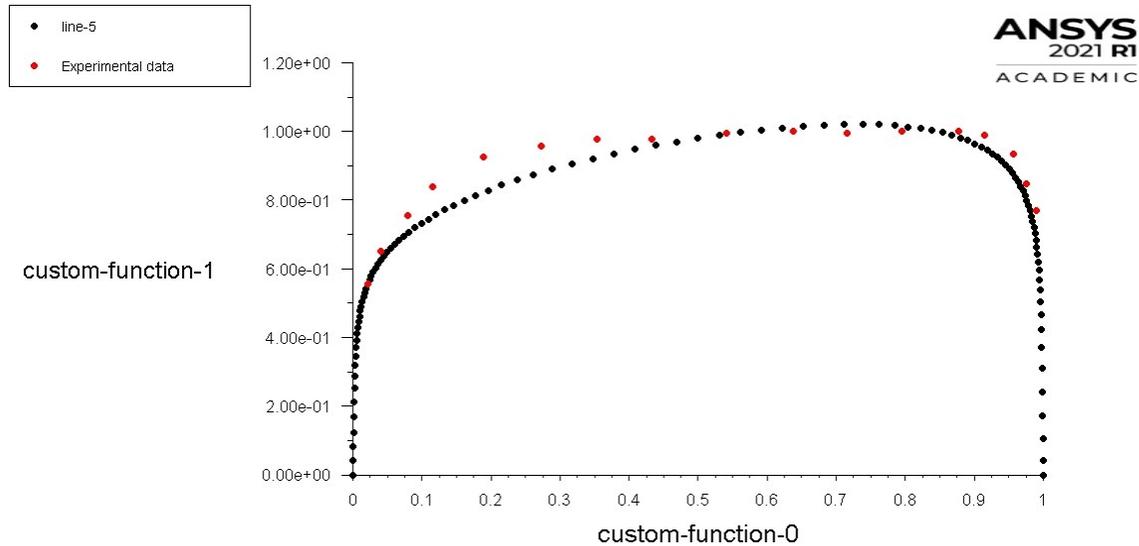
Curvature correction disabled
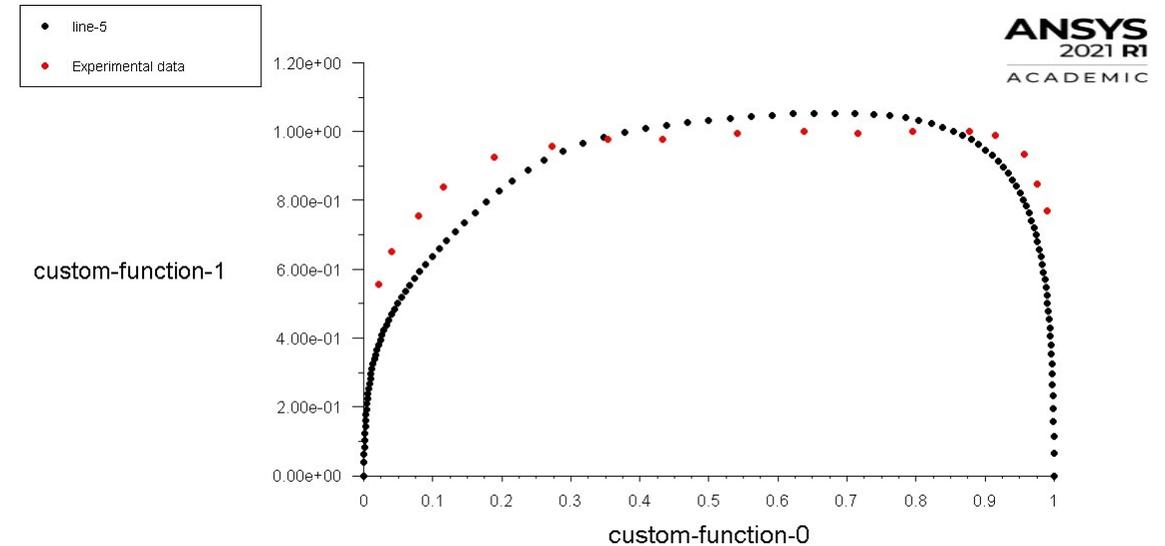
RSM model – Quadratic Pressure Strain (Epsilon)
This model is anisotropic.
No need to add curvature correction to the model

- Plots of non-dimensional velocity in function of the non-dimensional radial distance.
- The curvature correction limiter corrects deficiencies of EVM models due to system curvature.

Qualitative and quantitative results

A Study of the Effect of Curvature on Fully Developed Turbulent Flows
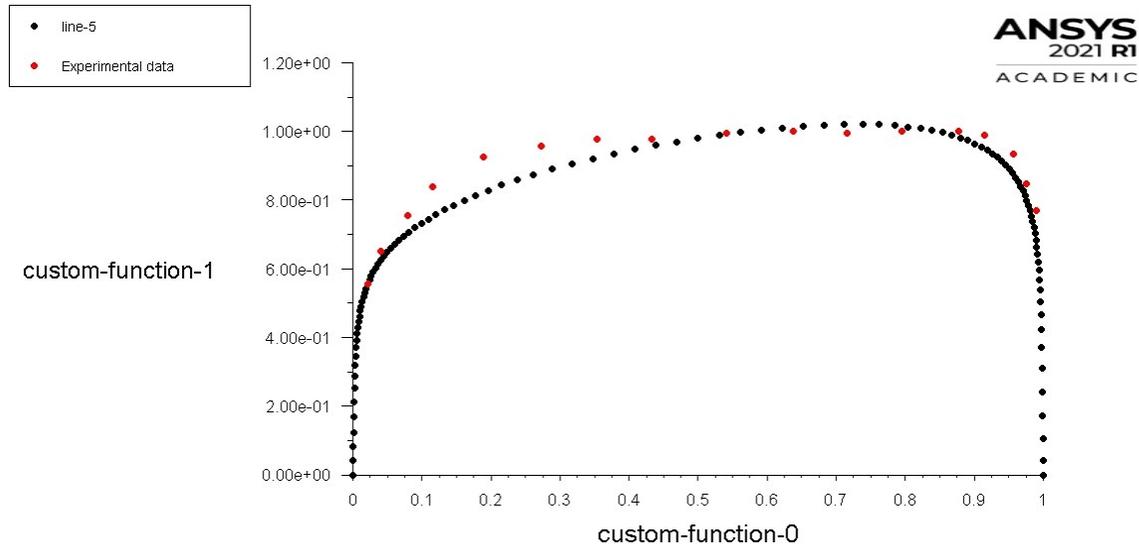
Curvature correction disabled
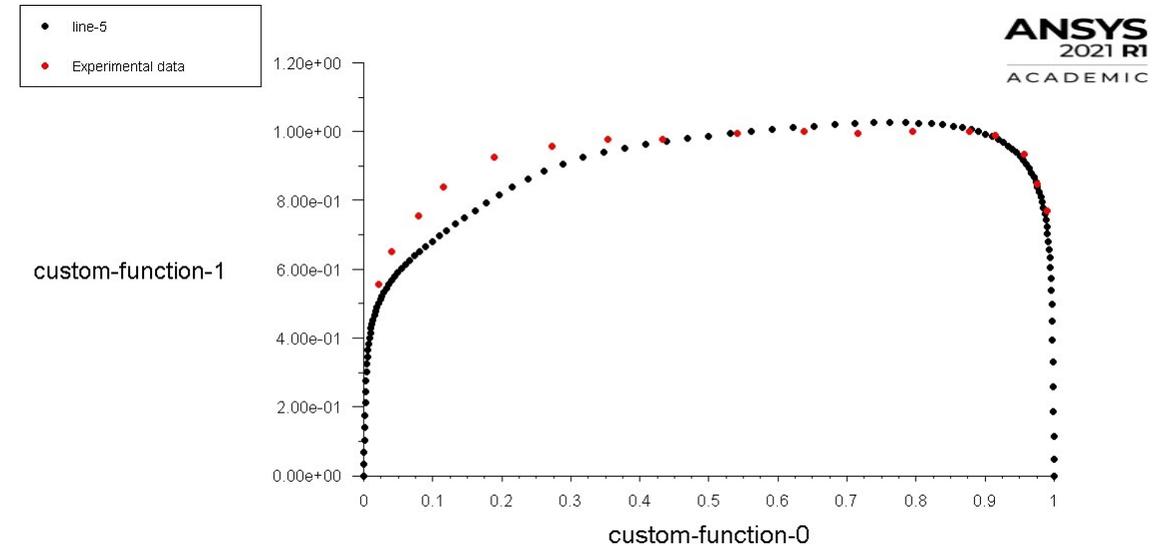
RSM model – Stress Omega (Omega)
This model is anisotropic.
No need to add curvature correction to the model

- Plots of non-dimensional velocity in function of the non-dimensional radial distance.
- The curvature correction limiter corrects deficiencies of EVM models due to system curvature.