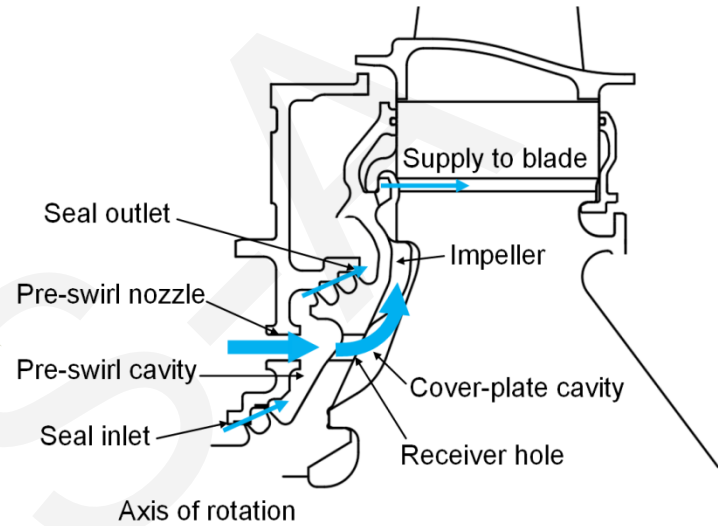
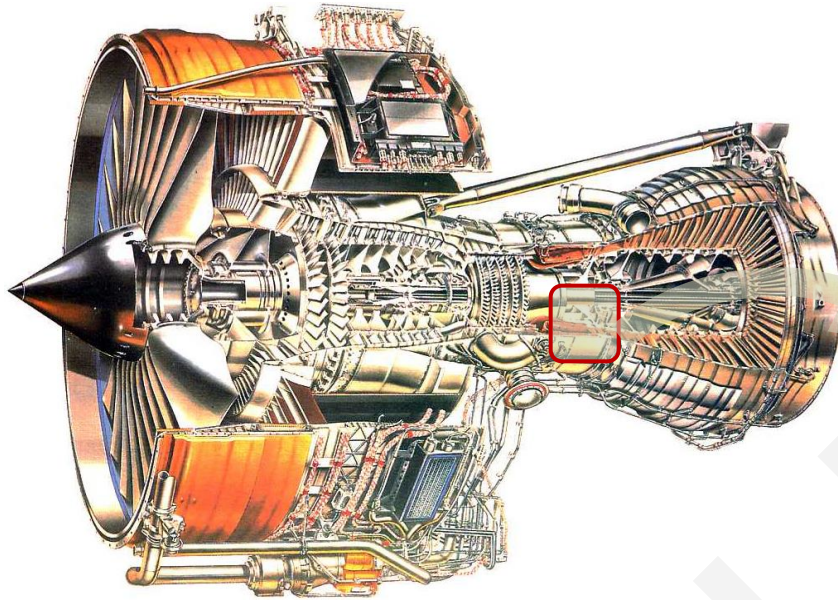


Numerical investigation of the transient process of a cover-plate pre-swirl system

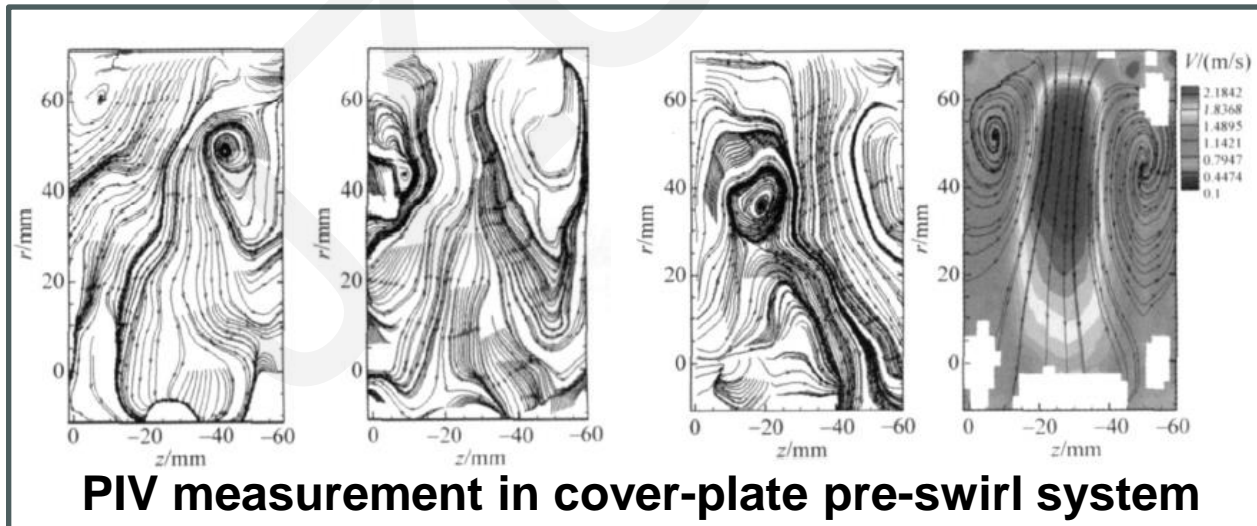
Yifu LUO, Qiang DU, Zengyan LIAN, Guang LIU, Lei XIE, Qingzong XU

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Pre-swirl system introduction



A typical cover-plate pre-swirl system



PIV measurement in cover-plate pre-swirl system

Numerical approach validation

Richardson-extrapolated solution: $f_{RE} = \frac{f_2^2 - f_1 f_3}{2f_2 - f_3 - f_1}$

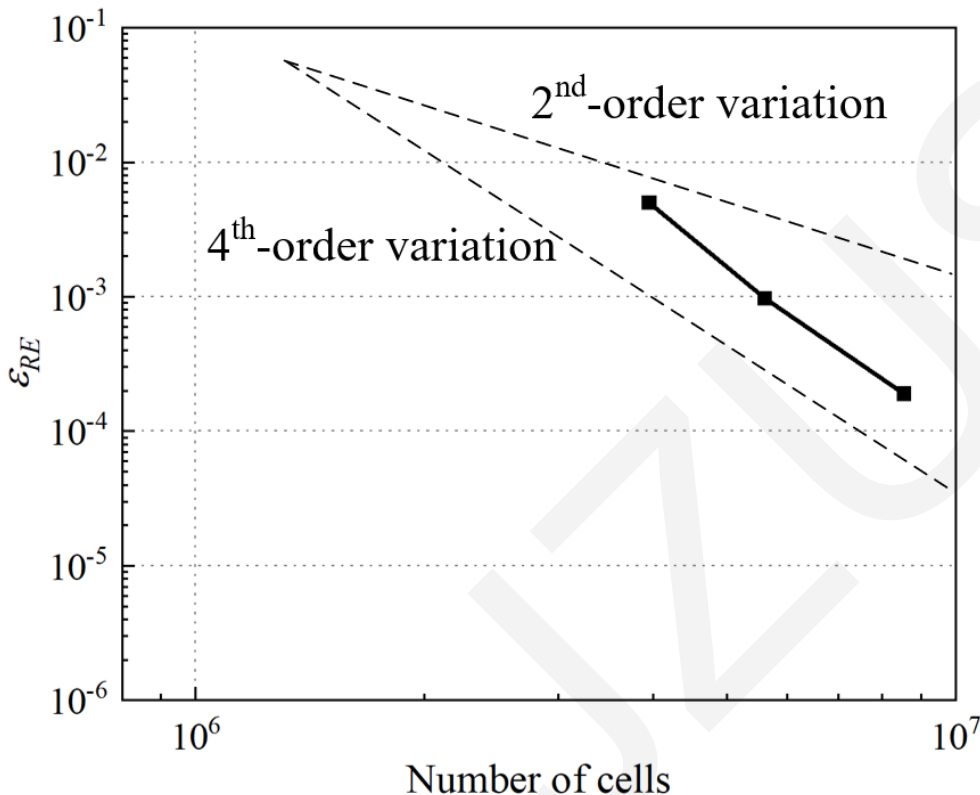


Fig. 4 Results of mesh independence validation

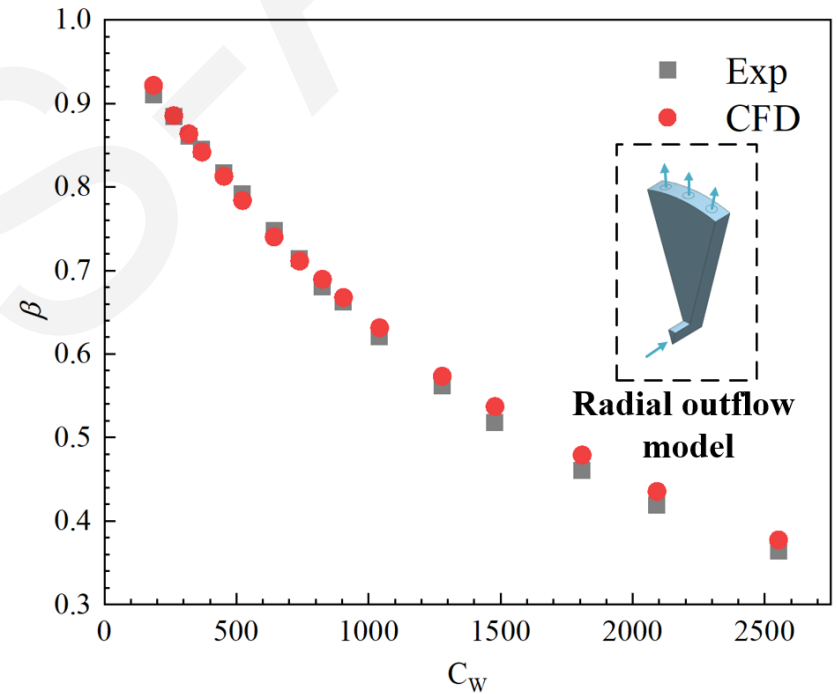


Fig. 6 Comparison of swirl ratio β between numerical prediction and experimental result (Owen et al., 1985) for the radial outflow model

Results and discussion

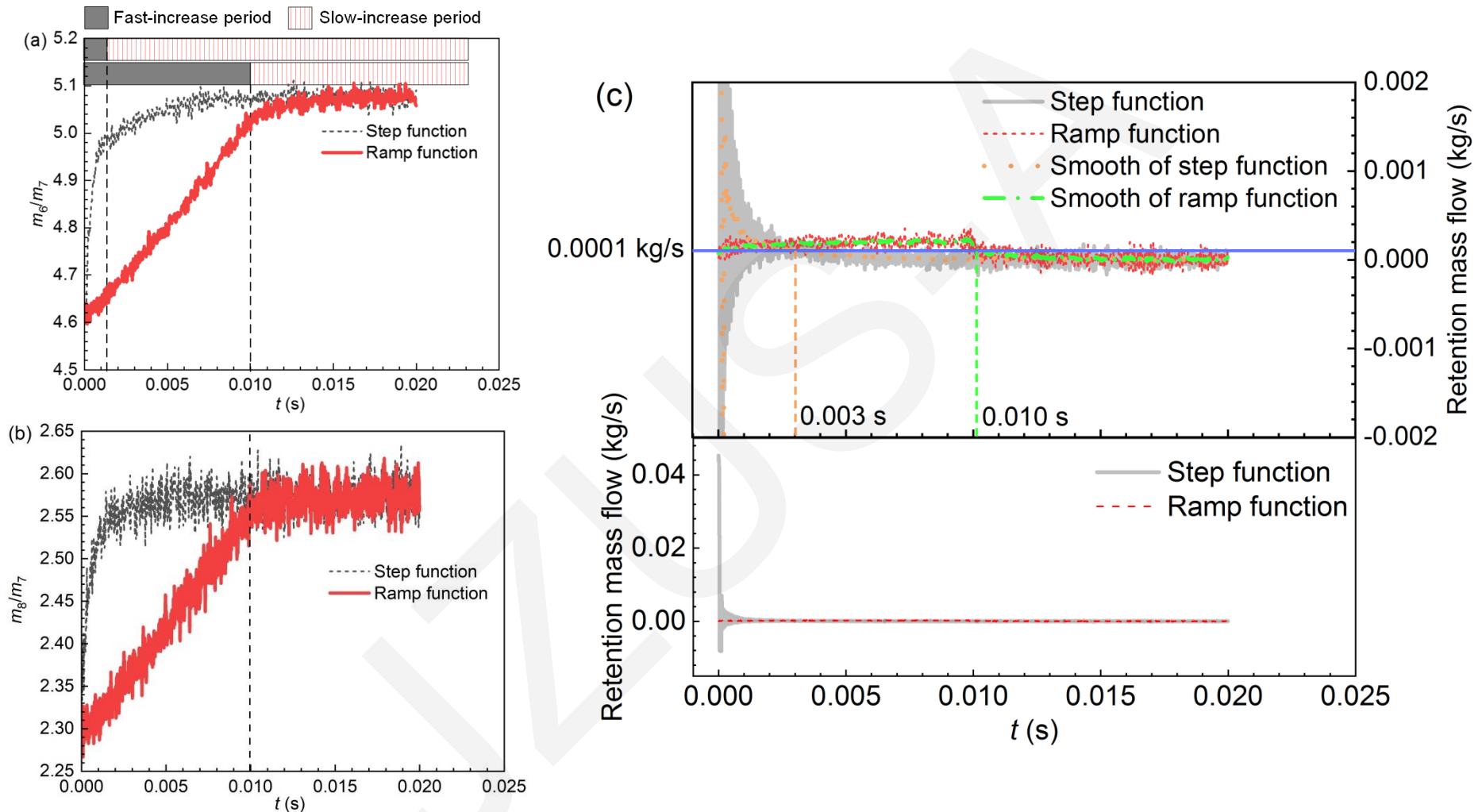


Fig. 8 Transient response of mass flow parameters of the pre-swirl system with step and ramp functions: (a) re-sponse of mass flow rate at outlet of the supply hole; (b) response of mass flow rate at the seal outlet; (c) response of retention mass flow for the pre-swirl system (the upper part is a localized magnified view)

Results and discussion

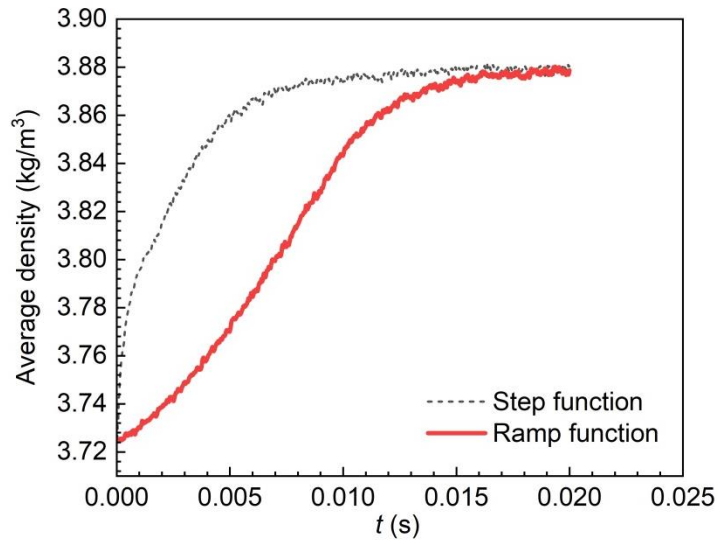


Fig. 9 Volume-average density in the cover-plate cavity response

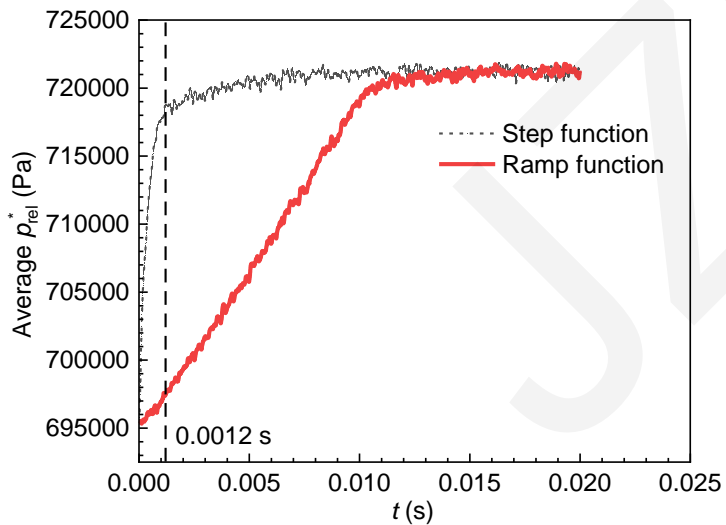


Fig. 10 Volume-average relative total pressure in the cover-plate cavity response

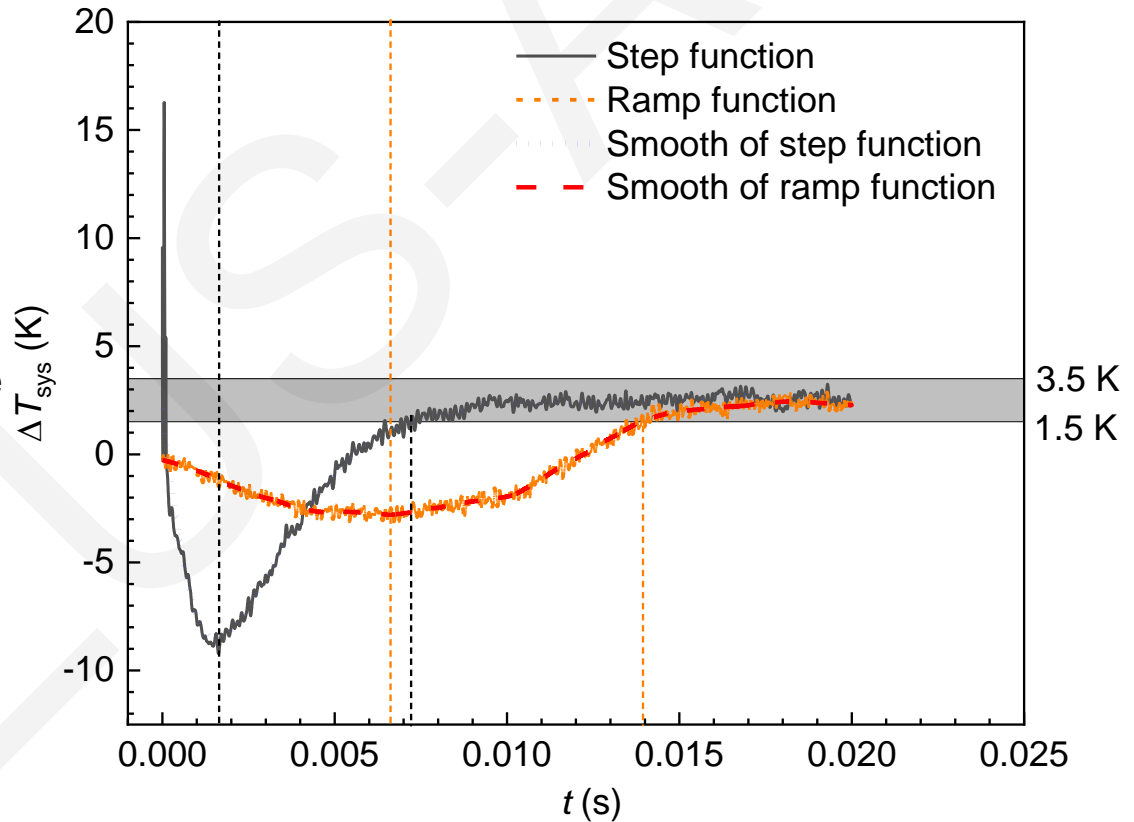


Fig. 11 Actual temperature-drop response for the pre-swirl system

Conclusions

- Our aim was to determine the effect of different inlet aerodynamic conditions for the step inlet, ramp inlet, and sinusoidal inlet. The results indicate that, among various parameters, the actual temperature drop exhibits a noticeable over-shoot phenomenon. Additionally, the influence of low-frequency inlet-flow fluctuation on the quality of blade air supply is more obvious than that of high frequency.



J. Mike Owen
1938-2021

Head of Department
Fellow of RAeS & ASME

Department of
Mechanical Engineering



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