Journal of Visualization, Vol. 3, No. 3 (2000) 205

1. Transonic Nonequilibrium Two-phase Wake Flow in Axial Cascades

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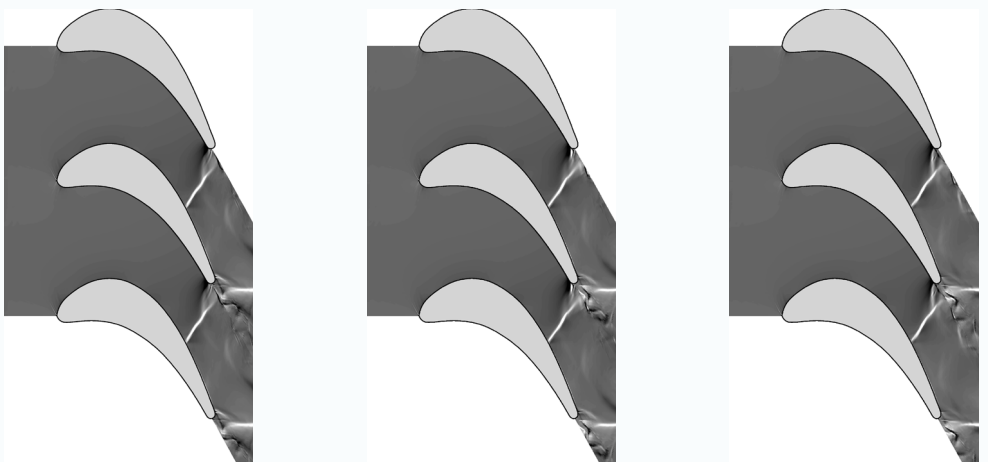
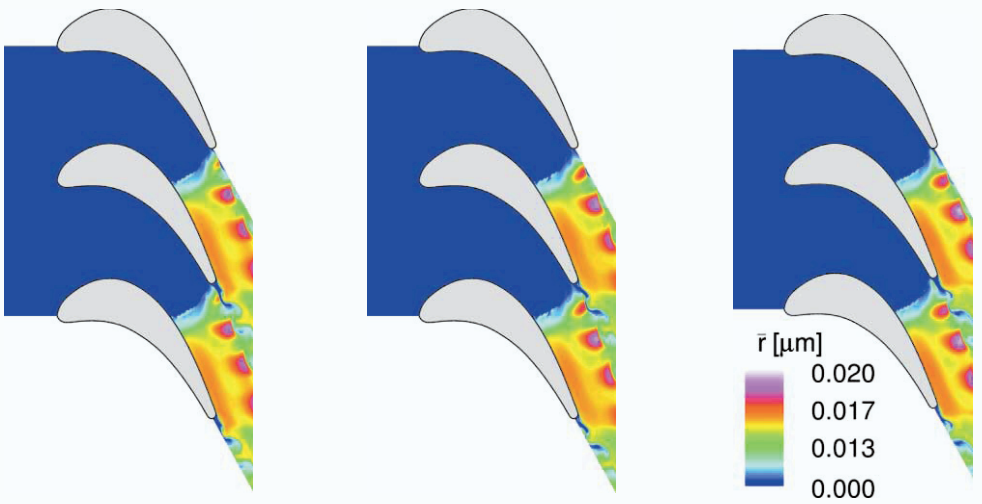
During the expansion in a low pressure steam turbine the thermodynamic state path of the vapor crosses the saturation line and the subsequent stages operate in the nonequilibrium two-phase regime with a highly dispersed mixture of steam and very tiny droplets. Rotor diameters of several meters yield, together with synchronizing to the line frequency of 50 or 60 Hz, circumferential speeds of 500-600 m/s which indicates the transonic/supersonic nature of the flow. Turbulent wakes interact with nucleation and droplet growth in the blade passage. From the color scale it can be seen that the biggest droplets develop near the wake and are convected downstream with a frequency of 22.5 kHz. The polydispersed radii spectrum at the exit plane covers about one order, from $2 \cdot 10^{-8}$m to $2 \cdot 10^{-7}$m.

Flow parameters: VKI turbine cascade, homogeneously condensing turbulent steam flow, $Re_2=1.15 \cdot 10^6$, $M_{2,is}=1.13$. Reservoir conditions of the steam: $T_{01}=357.5$K, $p_{01}=0.417$bar, $T_{01}-T_{sat}(p_{01})=7.5$K; vortex shedding frequency fvs=22.5kHz.



Top: Numerical Schlieren picture, local orientation of the knife edge normal to the local flow velocity vector.



Bottom: Averaged droplet radii distribution within the blade passage at three different instants of the vortex shedding frequency of $f_{vs}=22.5$kHz.