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PIV-Investigation of high-Reynolds number submerged water jets at high pressure ambient conditions
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Sarah Jasper
Bochum University of Applied Sciences
Institute for Thermodynamics and Fluid Mechanics
Am Hochschulcampus 1
44801 Bochum
Germany
t: +49 234 32 10432
e: sarah.jasper@hs-bochum.de

Jeanette Hussong
Technical University of Darmstadt
Fluid Mechanics and Aerodynamics
Darmstadt
Germany

Ralph Lindken
Bochum University of Applied Sciences
Institute for Thermodynamics and Fluid Mechanics
Bochum
Germany

Supplementary Material A

- statistical convergence of PIV data

In this supplementary material, we give additional information about statistical convergence of the measurement data. PIV measurements of the jet in both cavitating and non-cavitating regime were performed. We chose two experimental points with cavitation numbers $\sigma = 1.00$ and $\sigma = 1.67$, respectively. Temperature was maintained at T = 25 °C ±1,5K.
Statistical convergence of the data is evaluated at the centreline of the jet at the nozzle outlet. At this point, the measured mean velocity u_M averaged over a finite number of frames N_F is calculated. This averaged velocity u_M is related with the long-time average U_M which is averaged over 6000 frames by determining the relative deviation of both values. Figure A displays the results. The dashed lines in figure A show the 95% confidence interval after Adrian and Westerweel (2011)[1]. According to Adrian and Westerweel (2011), the sampling error for the mean velocity is proportional to the reciprocal of the root of the sample size if the turbulence intensity is significantly greater than the random fluctuations. We are convinced that this is a reasonable assumption for our measurements, too. Following that, the 95% confidence interval is determined with a turbulence intensity of 20% which is reasonable for the centre region of jets.

[1]Adrian RJ and Westerweel J (2011) Particle Image Velocimetry. Cambridge Univ. Press, Cambridge

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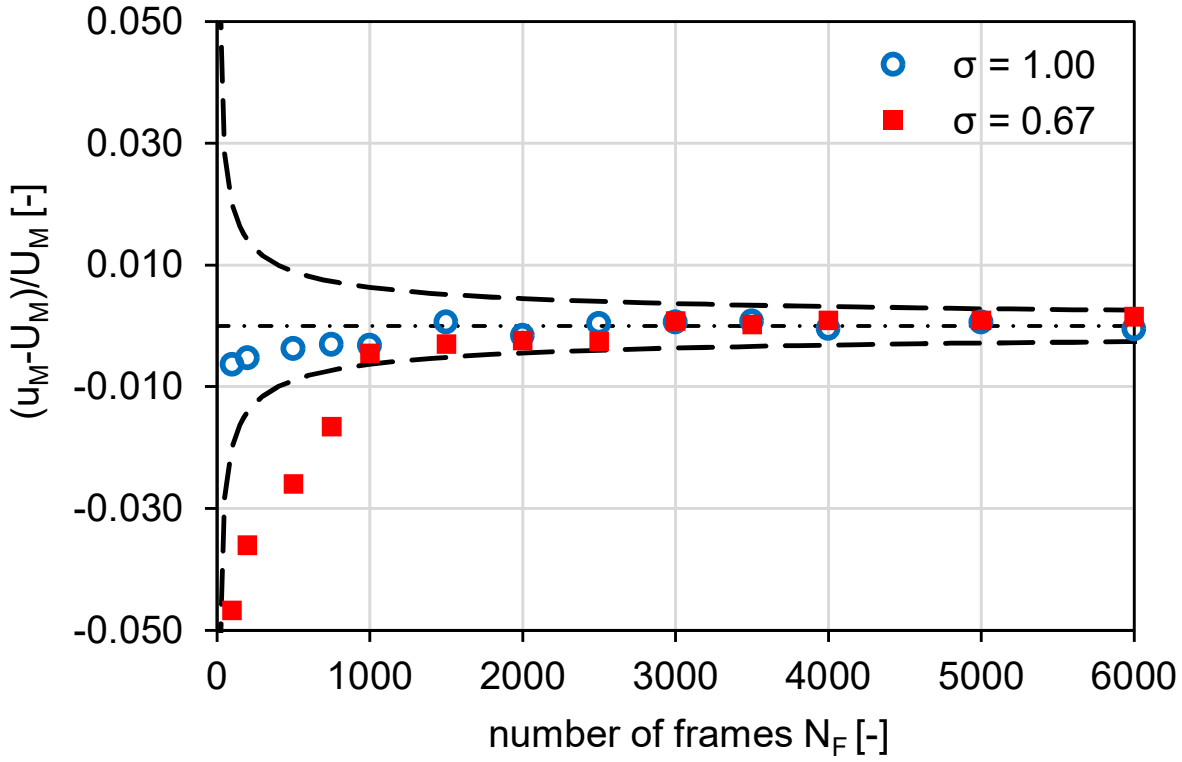

Figure A. Statistical convergence of measurement data shown by the difference between the measured mean velocity u_M averaged over a finite number of frames N_F and the long-time average U_M averaged over 6000 frames.

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Bubbles in the interrogation zone clearly influence the statistical convergence of the measurement data. Nevertheless, figure A shows that the minimum number of frames for statistical convergence is reached for 1000 frames. Statistical convergence of the data in the non-cavitating flow is not greatly influenced by the number of frames as expected. For both cavitating and non-cavitating flow the relative error is less than 0.5% for a sample size of 1000 frames. Further increase in sample size up to 6000 frames does not significantly lower the relative error.

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