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Derivation of a correlation for drag coefficient in two-dimensional bounded supercavitating flows, using artificial neural networks

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Abstract Artificial neural networks (ANNs) are used as a new approach for the determination of the relations between drag coefficient and Cavitation Number with cavity geometry in supercavitating flows which have been most widely used in the hydrodynamics researches. Also the result of the ANNs as a cost function potentially will be used in an optimization algorithm. Instead of complex differential equations and limited experimental data, faster and simpler solutions were obtained using equations derived from the ANN model. For training of the ANN the numerical results are used that are obtained from a boundary element method (BEM). At this problem, a two-dimensional supercavitation potential inviscid flow pasts a symmetric two-dimensional cavitator, which is placed perpendicular to the flow in a channel of infinite width and immediately a cavity is formed behind the cavitator. It was found that the coefficient of multiple determination (R^2-value) between the actual and ANN predicted data is equal to about 0.9998 for the drag coefficient and Cavitation number. As seen from the obtained results, the calculated cavity geometry for all drag coefficients and Cavitation Numbers are obviously within acceptable limits.

Keywords Supercavitation · Boundary element method · Artificial neural networks · Two-dimensional

List of symbols

cov	Coefficient of variation in percent
CGP	Pola-Ribiere conjugate gradient
C_D	Drag coefficient
d	Cavitator half width
D	Drag
H	Channel half height
L	Cavity half length
LM	Levenberg–Marquardt
MSE	Mean square error
o_{mean}	The mean value of all output data
P	Pressure
P_0	Undisturbed pressure
P_c	Cavity Pressure
q	Velocity

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