

Numerical Modelling of Free Surface and Cavitating Flows

Philip J. Zwart*
Ansys Canada Ltd.

May 2005

Contents

1	Introduction	2
1.1	Free Surface Flow	2
1.2	Cavitation	3
2	Mathematical Model	5
2.1	Multiphase Flow Model	5
2.2	Homogeneous Multiphase Flow Model	5
2.3	Cavitation Model	7
2.4	Turbulence Models	8
3	Numerical Model	9
3.1	Domain Discretization	9
3.2	Equation Discretization	9
3.2.1	Volume Fraction Equation	9
3.2.2	Momentum Equation	11
3.2.3	Volume Continuity Equation	11
3.2.4	Surface Tension	11
3.3	Solution Strategy	12
3.4	Parallel Scalability	13
4	Validation Examples	14
4.1	Free Surface Flow	14
4.1.1	Advection Tests	14
4.1.2	Transcritical Flow Over a Bump	14
4.1.3	Oscillating Manometer	16
4.2	Cavitation	16
4.2.1	Hydrofoil Cavitation	16
5	Conclusions	22

*The contributions of Prof. G. Raithby to the free surface model, Prof. A. Gerber to the cavitation model, and many discussions with fellow ANSYS CFX team members are gratefully acknowledged.