BOUNDARY INTEGRAL METHODS APPLIED TO CAVITATION BUBBLE DYNAMICS

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1. INTRODUCTION

Cavitation can occur in fast moving liquids whenever the local pressure in the liquid falls below a certain critical value (the vapour pressure) for a sufficient time. Bubbles form in a low pressure region and are swept away to regions of higher pressure where they collapse creating extremely high local velocities and pressure immediately adjacent to the bubble. This leads to noise, vibration and physical damage if the collapse occurs close to a solid boundary. Cavitation is a problem that has continuously plagued engineers in a variety of disciplines ranging from the aerospace engineer designing rocket pumps to the civil engineer concerned with the service life of spillway structures and energy dissipators. Cavitation can occur in fluid machinery: in all types of centrifugal pumps, also in turbines, propellers, underwater missiles, torpedoes and in piping systems near elbows, contractions and expansions of the pipe (see Arndt [1] for expansion on the above discussion).

The main objectives of our research programme in Cavitation Bubble Dynamics is to gain a better understanding of the potential mechanisms for causing damage to turbomachinery and other hydraulic devices (e.g. pitting, erosion). It is now thought that the damage mechanism is primarily due to a very high speed liquid jet impacting against the boundary. However, the direction and speed of the jet depends on the properties of the boundary; for example a rigid boundary "attracts"