Weekly CEAFM Seminar: Fall 2014

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, September 19, 2014**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Olivier Coutier-Delgosha** (École Nationale Supérieure d'Arts et Métiers)

Title: ***"Investigation of Cavitating Flows by Fast X-ray Imaging"***

Abstract

Lang Investigation of high speed two-phase flows characterized by large volume fractions of gas, such as cavitating flows, encounter strong difficulties. This is mainly due to the turbulent, biphasic, unsteady and compressible character of such flows, which induces an increased complexity for the use of any intrusive or non-intrusive measurement device. Therefore, their experimental analysis usually requires the development of specific means.

The presented work is devoted to the analysis of cavitating flows. It focuses on experimental measurements of the local void fraction and velocity fields in both the liquid and the vapor phases. For this purpose, an original method based on fast X-ray imaging was developed and applied to various configurations of hydrodynamic cavitation. The technique is based on the combination of a very intense X-ray beam, radio opaque tracers in the flow that cause local beam attenuation and/or phase contrast, a scintillator that converts X-rays into visible light, and a high speed high resolution camera that records the images of particles. The images also include all bubble interfaces, because of phase contrast at the interfaces and attenuation variations related to density ratios between liquid and vapor. It is supposed that the motion of the particles accounts for the liquid velocity (like in standard Particle Image Velocimetry), while the vapor dynamics can be obtained from the analysis of the bubble interfaces displacements, with some assumptions related to the characteristic time of bubble expansion and collapse. High frequency acquisition provides time-resolved information of the flow dynamics, while high spatial resolution enables to analyze the details of the flow turbulence. Difference of X-ray beam attenuation in the two phases also gives the local instantaneous volume fraction of the gas phase, as already demonstrated in previous work (Coutier-Delgosha et al. JFM, 2007).

In the future, analysis of the data will focus on the turbulent interactions between phases, since Reynolds stress tensors will be available in liquid and in vapor.