Boiling Readme

Description:

This dataset contains raw and annotated bubble images, as well as saved machine learning (ML) model weights. The data were collected from pool boiling experiments conducted on flat copper surfaces, copper microchannels, and copper foams. These images, captured using a Phantom VEO 710L high-speed camera, were used to train and test the ML models across diverse heater surfaces and operational conditions. The ML architecture named BubbleID was developed to identify both static and dynamic attributes of bubbles within sequences of high-speed boiling images. The static and dynamic attributes involve each bubble's location, dimensions, interface shape, and velocity over its lifetime, and capturing dynamic events such as bubble departure.

Data structure:

The dataset files can be read as follows:

The Data folder includes four subfolders, AnnotatedData, Models, TestData, Tutorials and a README file.

The *AnnotatedData* folder includes two subfolders and a readme file. This dataset contains pool boiling image data and annotations made in labelme.

- Classes-1: Annotations for liquid-vapor interfaces, including the training set, testing set, and a set from one pool boiling experiment, which does not appear in the other folders (Unseen-Test).
- Classes-2: Annotations for bubbles distinguishing between attached and detached bubbles.

The Models folder includes PyTorch model checkpoint file (.pth) saving the weights of pretrained models, including

seg_model.pth: pre-trained instance segmentation model

class_model.pth: pre-trained classification model

The TestData includes two subfolders:

SteadyStateTest for image sequences sampled at 3000 fps.

TransientSmallTest for image sequences sampled at 150 fps.

The Tutorials folder includes a Python Notebook script illustrating the steps for using the pretrained model and the BubbleID class for saving and displaying data extracted from bubble images/ videos.

References:

Dunlap, C., Li, C., Pandey, H., Le, N. and Hu, H., 2024. BubbleID: A deep learning framework for bubble interface dynamics analysis. Journal of Applied Physics, 136(1).