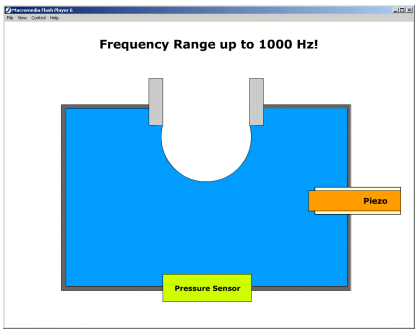
Oscillating Bubble Technique

Why is beer foam stable and why does champagne foam break down within seconds?
The answer is still a scientific dispute but the oscillating bubble technique may provide the answer. This technique has been developed at the Max-Planck Institute of Colloids and Interfaces. It measures the surface dilational E-modulus of aqueous surfactant solutions in a broad frequency range. Up to now, all investigations reveal a correlation between the lifetime of a foam lamella and the imaginary art of the complex E- module.
The principle of the oscillating bubble technique is sketched in the following figure showing the cross sectional view of the chamber.



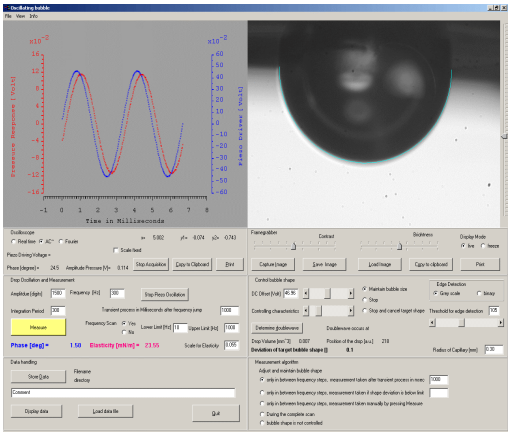
The chamber is filled with an aqueous surfactant solution. A small hemispherical bubble is formed at the tip of a capillary with a radius of about 0.2mm. The bubble is forced in a
sinusoidal oscillation by a piezoelectric translator which is directly immersed in the liquid. As a result, a harmonic modulation of the pressure in the chamber is observed and
recorded by a sensitive pressure transducer located at the bottom of the chamber.

The amplitude of the pressure response and the phase-shift between piezo oscillation
and pressure signal are evaluated via a phase sensitive lock-in detection scheme. The amplitude of the pressure response is proportional to the magnitude of the complex surface dilational module E, while the phase-shift yields the imaginary part of the modulus.

The system is completely controlled by a computer. The piezo motion is controlled by an AD-DA converter. Bubble and capillary are imaged by a video zoom imaging module, digitised and processed in a personal computer. The video system is crucial for maintaining the bubble size which is required for the compensation of thermal drifts within the chamber.

The programming tasks are as follows:

1. Simulate an oscilloscope and display the sinusoidal signals in real time mode
2. Image the oscillating bubble in real time mode
3. Trace the contour of the drop and maintain the half sphere geometry
4. Fourier transformation, fitting and number crunching, displaying of the results



Hubert Motschmann, group leader, MPI of Colloids and Interfaces, Germany