process typical of a non-linear dynamical system of high order [1], let us consider single bubble dynamical motion to underpin the rationale behind HOS analysis. Growth and collapse of a bubble can be equated to forced bubble oscillator resonant response as a function of hydrodynamic driving pressure.

The resonant frequency f_0 of a bubble with radius Ro at equilibrium can be given by Eq(1).[3]

$$f_0 \approx \frac{1}{2\pi}\sqrt{3\gamma\frac{\mathrm{P}_0 + 2\frac{\sigma}{\mathrm{R}_0}}{\rho_0 \mathrm{R}_0^2} - \frac{2\sigma}{\rho_0 \mathrm{R}_0^3}}. \tag{1}$$

where γ is the polytropic index (γ= 4/3 for adiabatic pulsations). P_0 is the hydrostatic pressure (P_0= 101 325 N m^{-2}), σ is the surface tension (σ= 0.072 Nm^{-1}). R_0 is the equilibrium bubble radius, ρ_0 is the equilibrium density of water (ρ_0= 1000 kg m^{-3}).

From (1) it can be found that the resonant value of the bubble radius for f_0 equal to the driving frequency (40kHz) is approximately 80.64 μm; 40kHz has been chosen as this represents the acoustic drive frequency of the cleaning vessel used to test the cavitation sensor concept [4]. In order to predict the variation of the radius of a cavitating bubble in a liquid when subject to a sinusoidally varying forcing pressure, the Gilmore equation was implemented. This equation is of the form [5]:

$$R(1 - \frac{\mathrm{U}}{\mathrm{c}})\frac{\mathrm{d}^2\mathrm{R}}{dr^2} + \frac{3}{2}(1 - \frac{\mathrm{U}}{3\mathrm{c}})(\frac{\mathrm{dR}}{\mathrm{dt}})^2 - (1 + \frac{\mathrm{U}}{\mathrm{c}})H - \frac{\mathrm{U}}{\mathrm{c}}(1 - \frac{\mathrm{U}}{\mathrm{c}})R\frac{\mathrm{dH}}{\mathrm{dR}} = 0. \tag{2}$$

where R is the bubble radius as a function of time t, $U = \frac{\mathrm{dR}}{\mathrm{dt}}$ is the bubble wall velocity, c is the sound velocity at the bubble wall. H is the specific enthalpy of the liquid. H and c are, respectively, given by [5]:

$$H = \int_{P(\infty)}^{P(R)} \frac{\mathrm{dP}}{\rho}, \tag{3}$$

and

$$c = [c_o^2 + (m-1)H]^{\frac{1}{2}} \tag{4}$$

where P is the time varying pressure of the liquid, ρ is the time- varying density of the liquid, c_0 is the velocity of sound in the unperturbed liquid, P(R) is the pressure