The wave front set of the Wigner distribution and instantaneous frequency

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Abstract: We study the wave front set of the Wigner distribution of a tempered distribution; for certain classes of data f we investigate the relations between the wave front set of f and the wave front set of the Wigner distribution of f. We apply these results to prove a formula for the so called 'Instantaneous Frequency', expressing the gradient of the phase function of a function $f : \mathbb{R}^d \mapsto \mathbb{C}$ as a normalized first frequency moment of the Wigner distribution for fixed time. The formula holds when $f \in \mathcal{FE}'$, or when f belongs to a Sobolev space $H^{d/2+1+\varepsilon}(\mathbb{R}^d)$ where $\varepsilon > 0$.