

I. Brief Introduction of the Project

(Involved field of science and technology, main technological contents, authorized patents, technical and economic indicators, application and promotion, talent cultivation, and promotion of science and technology progress in Macao)

The project is to develop signal analysis in relation to analytic phase derivative (analytic instantaneous frequency) and related applications. The background is Gabor's method and N. Huang's EMD method. Gabor's method was where we start with, while N. Huang's expectation for positivity of analytic phase derivative was set to be the goal of the project. Thanks to Gabor's process one can uniquely define phase function of a given signal via the associated analytic signal, but his method does not give non-negative and physically meaningful instantaneous frequency. The first task is to single out a class of signals that we later called by mono-components that have non-negative analytic phase derivative. The next steps are decomposition of signals into mono-components, and applications. The important results include: 1. Concept justification and the pool of mono-components; 2. Several types of mono-component decompositions; and 3. Applications. The study and practice present a trend of contemporary study leading by us, and development of Fourier theory. In the higher dimensions we use the quaternionic and Clifford algebra settings. Overall speaking the area of the studies and methods is in harmonic analysis (hard analysis) but uses a great deal of complex analysis (Clifford analysis if treating higher dimensions). It can be said to be complex methods of harmonic analysis. It has create a close attention by world mathematicians and engineers. Besides pure and applied international mathematical journals we also published, with high quality and quantity, in prestigious engineering journals (IEEE Trans on Signal Processing, Automatica, etc.) We offer an advanced Fourier theory. Some of our publications have attracted high citations. For instance, the initiative papers [QCL] Analytic unit quadrature signals with non-linear phase has been cited by 60; [Q17] Analytic Signals and Harmonic Measures cited by 38; [Q18] Characterization of boundary values of functions in Hardy spaces with applications in signal analysis cited by 44, etc. Some later papers, because of the high speed development, require more time to get recognized. For engineers it would take more time to become understanding.

⁽Not exceed 1,200 words)