

Experiments in Relation to Adaptive Decomposition of Signals into Mono-components

by Ho Io Tong

Thesis Supervisor:

Professor Tao Qian

Department of Mathematics

University of Macau

Abstract. In this study, we study the decomposition of signals, namely mono-component decomposition, in which signals are decomposed into a series of components, each of which has a non-negative instantaneous frequency.

Given a real-valued 2π -periodic signal f , let $\tilde{A}(f) = f + i\tilde{H}(f)$ to be the complex-valued analytic signal associated to f such that $\tilde{H}(\tilde{A}f) = -i\tilde{A}(f)$, where $\tilde{H}$ is the circular Hilbert transform. Rewrite $\tilde{A}f(t)$ in polar form $\rho(t)e^{i\theta(t)}$, then f is called mono-component if $\theta'(t) \geq 0$ almost everywhere. We know that if $\tilde{A}f$ is starlike on unit disc, then $\theta'(t) \geq 0$, hence f is mono-component. In this thesis, we make use of starlike criteria and Fourier series to construct a mono-component decomposition, and such decomposition is adaptive respect to the signals.

Introduction

In chapter 1, we introduce several mathematical tools, including 'Hilbert transform and Circular Hilbert transform', 'Analytic signal', 'Fourier Series', 'Numerical Circular Hilbert Transform', Möbois transforms and finite

Blaschke product', 'Starlike functions', 'p-valent starlike function'. With this preparation, we can discuss the objective of our thesis which mainly concerns with mono-component signals. Given any real-valued 2π -periodic signal f , our goal is to decompose the given signals into a sum of mono-component signals, and we propose an adaptive algorithm which solves this problem in chapter 2.

Chapter 2 concerns with adaptive decomposition of signals, we first recall Empirical mode decomposition(EMD) method briefly. And then we state several theorems which provide the basis of our algorithm before we state our decomposition method. Our main results are theorem (2.2.3) , theorem (2.2.6), theorem (2.2.8) and corollary (2.2.7). Finally, we illustrate the result of our algorithm by using some real data with figures to explain the meaning of our main theorems.