

# Estimating the Parameters of Multiple Chirp Signals

Ananya Lahiri\*

Chennnai Mathematical Institute, Chennai, India. alahiri@cmi.ac.in

Debasis Kundu

Department of Mathematics and Statistics,  
Indian Institute of Technology Kanpur, India. kundu@iitk.ac.in

Amit Mitra

Department of Mathematics and Statistics,  
Indian Institute of Technology Kanpur, India. amitra@iitk.ac.in

## Abstract

Chirp signals occur quite naturally in different areas of signal processing. Recently the least squares estimators of the unknown parameters of a chirp signal model has been considered and their consistency and asymptotic normality properties have been established. It is observed that the dispersion matrix of the asymptotic distribution of the least squares estimators is quite complicated. The aim this paper is two fold. First using a number theoretic result of Vinogradov, we present a simplified form of the above mentioned dispersion matrix. Secondly, using the orthogonal structure of the different chirp components, we propose a sequential estimation procedure of the different parameters step by step. It reduces to solve only a two dimensional optimization problem at each step. It is observed that the estimators obtained by the proposed method are strongly consistent. Due to complicated nature of the model, we could not establish the asymptotic distribution of the proposed sequential estimators. We perform some simulation experiments to compare the performance of proposed and least squares estimators for small sample sizes, and for different parameter values. It is observed that the mean squared error of the proposed estimators are very close to the corresponding mean squared errors of the least squares errors. Two real data sets have been analyzed for illustrative purposes.

**Key Words and Phrases:** Chirp signals; least squares estimators; strong consistency; asymptotic distribution.