Application of the AAK theory and Prony-like methods for approximation of exponential sums

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Considering an l^1-sequence $f := (f_k)_{k=0}^{\infty}$ represented by an exponential sum of the form

$$f_k = \sum_{j=1}^{N} a_j z_j^k$$

where $0 < |z_N| < \ldots < |z_1| < 1$ and $N \in \mathbb{N}$ we provide a new method for approximation of f by a shorter exponential sum of length $n < N$. For this purpose our method combines Prony-like reconstruction methods with the so-called AAK-theory (Adamjan, Arov, Krein, 1971). The method is based on a dimension reduction approach for the infinite Hankel matrix $\Gamma_f := (f_{j+k})_{j,k=0}^{\infty}$ given in terms of f. The length of the approximation sum can be chosen in advance and the AAK-theorem yields the corresponding error estimation in terms of the eigenvalues of Γ_f.