



Improved Annihilating Filter

Julie Djeffal & Niroshan Vijayarasa

Statistical Signal and Data Processing through applications - May 2019



Introduction

- The Annihilating filter is a filter used to find the positions of the spectral lines of an harmonic signal of K components.
- Based on zero finding, it can find the position of the spectral lines using only $2K$ samples
- It works poorly in the presence of Noise



Motivations

- Annihilating Filter works poorly in the presence of noise.
- While there exist methods more robust in presence of noise, they are not as efficient as the annihilating filter (MUSIC algorithm for example)
- We could use a more efficient algorithm for line spectrum detection in the presence of noise



Improved Annihilating Filter

The Annihilating Filter can be more robust to noise by replacing the exact solution by an optimisation.

$$\min_{c,x} ||y - Gx||_2^2$$

subject to: $c * x = 0$,



Improved Annihilating Filter

Algorithm 1: Robust FRI Signal Reconstruction

Input : Measurements \mathbf{a} of the FRI signal, transformation matrix \mathbf{G} , noise level ε^2

Output: Uniform sinusoid samples \mathbf{b} , annihilating filter coefficients \mathbf{c}

for $loop \leftarrow 1$ **to** *max. initializations* **do**

1 Initialize \mathbf{c} with a random vector \mathbf{c}_0 ;

for $n \leftarrow 1$ **to** *max. iterations* **do**

2 Build the augmented matrix with \mathbf{c}_{n-1} and update \mathbf{c}_n by solving (2.4);

3 Build the augmented matrix with \mathbf{c}_n and update \mathbf{b}_n by solving (2.5);

if $\|\mathbf{a} - \mathbf{G}\mathbf{b}_n\|_2^2 \leq \varepsilon^2$ **then**

4 Terminate both loops;

end

end

end

5 $\mathbf{b} \leftarrow \mathbf{b}_n, \mathbf{c} \leftarrow \mathbf{c}_n.$
