T2: Applications of Polynomial Eigenvalue Decomposition to Multichannel Broadband Signal Processing
Part V: Concluding Remarks and Closing

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Outline

1. PEVD Tutorial Outline
2. Applications of PEVD
3. Future Work
4. PEVD Resources

PEVD Tutorial Outline

Recap: PEVD Tutorial Outline

1. Part I: Background
2. Part II: Eigenvalue Decomposition
3. Break
4. Part III: Subband Coding via Polynomial EVD
5. Part IV: Speech Processing Applications
6. Part V: Concluding Remarks and Closing

- Highlighted differences between EVD and PEVD
- Explained why PEVD suits multichannel broadband signal processing
- Demonstrated some application examples

Applications of PEVD

Applications of PEVD

The following list contains some examples of PEVD applications:

1. Beamforming [Weiss2015; Neo2022a]
2. Communications [Brandt2011; Hassan2019; Hassan2021]
3. Direction of Arrival Estimation [Alrmah2011; Weiss2013; Hogg2021]
4. Speech Enhancement [Neo2021a]
5. Source Separation [Redif2017; Redif 2017; Neo2021b]
6. Source and System Identification [Weiss2017; Khattak2022]
7. Subband Coding [Redif2011]
8. Weak Transient/Voice Activity Detection [Weiss2021; Neo2022b; Neo2022c]

Not all applications have been covered in this tutorial. Feel free to initiate a discussion with us.

Future Work

Future Work

- Similar extensions from EVD to analytic or polynomial EVD for other linear algebraic decompositions, e.g., non-parahermitian EVD, SVD, QR decomposition, generalized SVD
- Polynomial equivalents to extend narrowband ICA
- Further algorithmic improvements for scalability

PEVD Resources

Look out for our IEEE Signal Processing Magazine Article.

Polynomial Eigenvalue Decomposition for Multichannel Broadband Signal Processing

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***Index Terms*—Polynomial matrix, polynomial eigenvalue decomposition, multichannel broadband processing, space-time covariance matrix, lossless filter banks, broadband beamforming, subband coding, speech enhancement**

I. Introduction

This article is devoted to the polynomial eigenvalue decomposition (PEVD) and its applications in broadband multichannel signal processing, motivated by the optimum solutions

optimum solutions. For example, the multiple signal classification (MUSIC) algorithm uses an EVD of the instantaneous spatial covariance matrix to perform super-resolution direction finding [5], [10].

The defining feature of a narrowband problem is the fact that a time delayed version of a signal can be approximated by the undelayed signal multiplied by a phase shift. The success of narrowband processing therefore depends on the accuracy of this approximation which varies from problem to problem.

PEVD Resources

- Code
  - PEVD Tool: http://pevd-toolbox.eee.strath.ac.uk
  - PEVD-based Speech Enhancement: https://github.com/vwn09/pevd-speech-enhance
- Demo Pages
  - Speech Enhancement Demo: https://vwn09.github.io/pevd-enhance/
  - Signal Compaction Using PEVD for Spherical Array Processing with Applications: https://vwn09.github.io/pevd-smap/
  - PEVD Fixed Beamformers: https://vwn09.github.io/research/pevd-beamformer-iwaenc
  - Voice Activity Detection: https://vwn09.github.io/research/pevd-tsvad-iwaenc

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Thank You

Feel free to contact us if you have further questions.

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