DATA-CENTRIC DISTRIBUTED SIGNAL PROCESSING FOR SPATIAL FILTERING IN WIRELESS SENSOR NETWORKS

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Project abstract:

Spatial filtering consists of combining sensor signals measured at different locations into a new signal with better properties (for example a better signal-to-noise ratio). This technique is widely used in biomedical signal processing, wireless communication, and acoustics. With the emergence of wireless sensor networks (WSNs), many applications require a fully distributed approach to solve spatial filtering problems in order to reduce the energy and bandwidth requirements. For this purpose, we have recently developed a unifying algorithmic framework that allows to design such distributed algorithms for a large spectrum of spatial filtering problems. However, in its current form the resulting meta-algorithm does not properly handle non-stationary settings (i.e., where the sensor signal statistics change over time), and suffers from suboptimal convergence when the spatial filter design involves constrained optimization techniques. The goal of this project is to rethink the algorithm and propose extensions to alleviate these fundamental shortcomings. To demonstrate the practical relevance of our contribution, we apply the framework on several use cases in the context of wearable encephalography sensor networks for brain-computer interfacing.

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Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

Dataset name / ID	Description	New or reuse	Digital or Physical data	Data Type	File format	Data volume	Physical volume
EEG256	This dataset consists of the EEG recordings of 30 human subjects consisting of 4 different experiments.	Existing data	D(igital)	Numerical	Database (.dat, .dap, .rs3, .ceo)	<1TB	NA

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

The EEG256 dataset consists of 4 different experiments. The auditory attention decoding (AAD) experiment has already been published: https://zenodo.org/records/4518754
The rest of the data, consisting of the other 3 experiments is not publicly available and is stored in the servers of the research unit.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, refer to specific datasets or data types when appropriate and provide the relevant ethical approval number.

- Yes, human subject data (Provide SMEC or EC approval number below)

SMEC: G- 2018 11 1379

Will you process personal data? If so, please refer to specific datasets or data types when appropriate and provide the KU Leuven or UZ Leuven privacy register number (G or S number).

- Yes (Provide PRET G-number or EC S-number below)

G- 2018 11 1379

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- Yes

As the main output of this project will be algorithms, certain companies could be interested in using them. The algorithm codes will be put online, however the dataset will not be shared.

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material or Data transfer agreements, Research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- Yes

The dataset can only be used by authorized researchers within the research unit.

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g. in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, codebook.tsv etc. where this information is recorded).

In this project, the main outcome will be algorithms and software using existing data. Therefore, the data is already documented, while the algorithms resulting from this project will be clearly documented in README.txt or README.md files, and also in published articles.

Will a metadata standard be used to make it easier to find and reuse the data?
If so, please specify which metadata standard will be used.

If not, please specify which metadata will be created to make the data easier to find and reuse.

- No

Metadata with information on experiments carried out with the developed algorithms will be provided in .txt files.

Data Storage & Back-up during the Research Project

Where will the data be stored?

- Large Volume Storage

The data used in the course of this project is stored on the storage facilities of the research unit (STADIUS, 8 TB capacity)

How will the data be backed up?

- Other (specify below)

The data is backed up daily. Its storage and back up is the responsibility of the IT support of the faculty (ESAT).

Is there currently sufficient storage & backup capacity during the project?

If no or insufficient storage or backup capacities are available, explain how this will be taken care of.

- Yes

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

The data stored in the STADIUS servers has access regulated by an access control list (ACL) that grants: read-write access to the project owner read-only access to specific users The ACL is managed by the project owner (promotor) and the STADIUS data manager. Client computers can access the data using: SMB2 (or higher) from specific IP ranges NFSv4 from specific (IT managed) systems.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

The storage facilities of the department are available for researchers of the unit for free.

Data Preservation after the end of the Research Project

Which data will be retained for 10 years (or longer, in agreement with other retention policies that are applicable) after the end of the project?

In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

- All data will be preserved for 10 years according to KU Leuven RDM policy

Where will these data be archived (stored and curated for the long-term)?

- Other (specify below)

After the period of 10 years, any data generated in the course of the project that is not longer in use will be removed from the department's servers.

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

The storage facilities of the department are available for researchers of the unit for free.

Data Sharing and Reuse

Will the data (or part of the data) be made available for reuse after/during the project?
Please explain per dataset or data type which data will be made available.

- Yes, as restricted data (upon approval, or institutional access only)

If access is restricted, please specify who will be able to access the data and under what conditions.

Part of the data is publicly available at:
https://zenodo.org/records/4518754
The rest of the data is not publicly available and stored in the servers of the research unit and can only be accessed by researchers from the unit that will work with this dataset.

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal

restrictions)?

Please explain per dataset or data type where appropriate.

- Yes, privacy aspects

The data cannot be shared beyond project collaborators because these are personal data (special category data: health data), and this has been agreed to by the participants in the Informed Consent Form.

Where will the data be made available?

If already known, please provide a repository per dataset or data type.

- Other (specify below)

The data will only be shared with researchers working on the same project in Alexander Bertrand's research team at KU Leuven.

When will the data be made available?

- Other (specify below)

Restricted access repository: By giving these persons access to the databases in the secure server at ESAT.

Which data usage licenses are you going to provide?

If none, please explain why.

- Other (specify below)

Do you intend to add a persistent identifier (PID) to your dataset(s), e.g. a DOI or accession number? If already available, please provide it here.

- No

What are the expected costs for data sharing? How will these costs be covered?

The costs of keeping the data on the secure server are covered by the ESAT department of KU Leuven.

Responsibilities

Who will manage data documentation and metadata during the research project?

The researcher is responsible for documentation & metadata.

Who will manage data storage and backup during the research project?

The researcher and the research unit.

Who will manage data preservation and sharing?

The PI, Alexander Bertrand.

Who will update and implement this DMP?

The PI bears the end responsibility of updating & implementing this DMP.