User-centric distributed signal processing algorithms for next generation cell-free massive MIMO based wireless communication networks

A Data Management Plan created using DMPonline.be

Creators: n.n. n.n., Aldona Niemiro-Sznajder, Marc Moonen, Hazem Sallouha https://orcid.org/0000-0002-1288-1023

Affiliation: KU Leuven (KUL)

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Principal Investigator: Marc Moonen, Hazem Sallouha https://orcid.org/0000-0002-1288-1023, n.n. n.n.

Data Manager: Aldona Niemiro-Sznajder

Project Administrator: Aldona Niemiro-Sznajder

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Project abstract:

The project considers so-called cell-free massive MIMO (CFmMIMO) systems for next-generation wireless communication networks. Unlike in current cellular systems, where a user is served only by the one access point (AP) of the cell in which it resides, in a CFmMIMO system a user may be served by all APs in the network. This can resolve current interference issues and potentially offer significantly higher spectral efficiency.

The goal of the project will be to develop novel and efficient distributed signal processing algorithms, to reap the full CFmMIMO benefits at a practically affordable cost, i.e., not relying on centralized processing and with a computational complexity and inter-AP communication cost that is scalable for large networks with many users and many APs. A user-centric approach will be taken, where a user is served by a selected set of APs, forming local ad-hoc networks that optimally cooperate by sharing fused signals and parameters as coordinated by the distributed algorithms. Specific signal processing challenges will be addressed in this general context, namely synchronization, channel estimation, equalization, precoding, and resource allocation.

The project will build on earlier research on distributed node-specific signal estimation in wireless (acoustic) sensor networks, resource allocation in fixed-access DSL networks, as well as on in-house expertise in experimentally-driven mMIMO channel estimation and distributed signal processing.

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FWO DMP (Flemish Standard DMP)

1. 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.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
		Please choose from the following options: • Generate new data • Reuse existing data	*Please choose from the following options:* • Digital • Physical	*Please choose from the following options:* • Observational • Experimental • Compiled/aggregated data • Simulation data • Software • Other • NA	*Please choose from the following options:* • .por, .xml, .tab, .cvs,.pdf, .txt, .rtf, .dwg, .gml, ... • NA	*Please choose from the following options:* • <100MB • <1GB • <100GB • <1TB • <5TB • <10TB • <50TB • >50TB • NA	
Network-wide CF-mMIMO algorithms	All code developed in WP1	Generate new data	Digital	Software	.m, .py, .txt	<1GB	
User-centric CF-mMIMO algorithms	All code developed in WP2	Generate new data	Digital	Software	.m, .py, .txt	<1GB	
Distributed CF-mMIMO algorithms	All code developed in WP3	Generate new data	Digital	Software	.m, .py, .txt	<1GB	
Network-wide CF-mMIMO data	All simulation scenarios and results in WP1	Generate new data	Digital	Simulation data	.mat, .txt	<100GB	
User-centric CF-mMIMO data	All simulation scenarios and results in WP2	Generate new data	Digital	Simulation data	.mat, .txt	<100GB	
Distributed CF-mMIMO data	All simulation scenarios and results in WP3	Generate new data	Digital	Simulation data	.mat, .txt	<100GB	

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:

Data used to validate research results will mainly consist of:
1) documents in common electronic formats (reports, papers)
2) measurements in JSON and CSV formats
3) analytical and numerical simulation codes in software specific file formats (Matlab m-files, Julia, Python and C code)
4) raw numerical data and multimedia files.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

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

The potential for valorization will be assessed before sharing any data.

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/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.

- No

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

2. 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).

Raw data will be generated as output from measurements and simulation codes and will be exported in standard formats that can be imported into other software packages for postprocessing. Metadata about the data sets with specific information about the numerical runs will be stored in associated text files, alongside the datasets on KU Leuven RDR.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

3. Data storage & back-up during the research project

Where will the data be stored?

- The data will be stored in ESAT servers with access regulated by an access control list (ACL) that grants read-write access to the PIs and read-only access to specific users. The ACL is managed by the PIs. Client computers can access the data using SMB2 (or higher) from specific IP ranges and NFSv4 from specific (IT managed) systems.
- Measurements and datasets will be made open-source by publishing it on KU Leuven RDR on a permanent basis.
- Codes and software will be stored on KU Leuven GitLab.

How will the data be backed up?

All data in ESAT servers are backed up daily and replicated to an off-site storage system in the KU Leuven ICTS data center.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

Yes, the data is stored on the server assigned for research data of the STADIUS (PI Marc Moonen) and WaveCore (PI Sofie Pollin) research divisions.
Both STADIUS and WaveCore research divisions are constantly monitoring their storage capacity and extend it if needed.

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

The data will be stored in ESAT servers with access regulated by an access control list (ACL) that grants read-write access to the PIs and readonly access to specific users. The ACL is managed by the PIs. Client computers can access the data using SMB2 (or higher) from specific IP ranges and NFSv4 from specific (IT managed) systems.
Data stored at KU Leuven servers are protected by the KU Leuven ICT department.

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

The costs of storage and backup of the data is covered by the research divisions STADIUS (PI Marc Moonen) and WaveCore (PI Sofie Pollin).

4. Data preservation after the end of the research project

Which data will be retained for at least five 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...).

Following KU Leuven's RDM policy, research datasets will be kept for 10 years. Limited data of high value (e.g., validation datasets) will be made public on a more permanent basis.

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

The data will be stored in ESAT servers during the project and 5 years after the project ends. Later, the data will be moved to the offline data archive storage.
Following KU Leuven's RDM policy, research datasets will be kept for 10 years. Limited data of high value (e.g., validation datasets) will be made public on a more permanent basis.

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

The storage facilities of the research unit are available to the researchers free of charge.

5. Data sharing and reuse

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

- Yes, in an Open Access repository

Whenever relevant code and data sets accompanying publications will be posted in KU Leuven RDR, possibly also in IEEE CodeOcean and IEEE DataPort, under an open access CC-BY licence.

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

NA

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 in the comment section per dataset or data type where appropriate.

- No

Where will the data be made available? If already known, please provide a repository per dataset or data type.

Whenever relevant code and data sets accompanying publications will be posted in KU Leuven RDR, possibly also in IEEE CodeOcean and IEEE DataPort, under an open access CC-BY licence.

When will the data be made available?

Data will be made available upon publication of research results.

Which data usage licenses are you going to provide? If none, please explain why.

Whenever relevant code and data sets accompanying publications will be posted in KU Leuven RDR, possibly also in IEEE CodeOcean and IEEE DataPort, under an open access CC-BY licence

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

Code and data sets posted in KU Leuven RDR, IEEE CodeOcean and IEEE DataPort receive a DOI

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

All open access fees will be covered by the project budget and/or neighbouring projects by the PIs.

6. Responsibilities

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

Researchers employed in the project

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

Researchers employed in the project

Who will manage data preservation and sharing?

PIs Marc Moonen and Sofie Pollin

Who will update and implement this DMP?

PIs Marc Moonen and Sofie Pollin

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Application DMP

Questionnaire

Describe the datatypes (surveys, sequences, manuscripts, objects …) the research will collect and/or generate and /or (re)use. (use up to 700 characters)

Data used to validate research results will be generated by the PIs and their teams. The data will mainly consist of:
1) documents in common electronic formats (reports, papers).
2) measurements in JSON and CSV formats.
3) analytical and numerical simulation codes in software specific file formats (Matlab m-files, Julia, Python and C code).
4) raw numerical data and multimedia files. Raw data will be generated as output from measurements and simulation codes and will be exported in standard formats that can be imported into other software packages for postprocessing. Metadata about the data sets with specific information about the numerical runs will be stored in associated text files alongside the dataset on KU Leuven RDR.

Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)

The PIs will be responsible for the data preservation.
- Documents and reports will be stored in ESAT servers with access regulated by an access control list (ACL) that grants read-write access to the PIs and read-only access to specific users. The ACL is managed by the PIs. Client computers can access the data using SMB2 (or higher) from specific IP ranges and NFSv4 from specific (IT managed) systems. All data in ESAT servers are backed up daily and replicated to an off-site storage system in the KU Leuven ICTS data center.
- Measurements and datasets will be made open-source by publishing it on KU Leuven RDR on a permanent basis.
- Codes and software will be stored on KU Leuven GitLab.
Following KU Leuven's RDM policy, research datasets will be kept for 10 years. Limited data of high value (e.g., validation datasets) will be made public on a more permanent basis.

What’s the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)

NA

Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)

NA

Which other issues related to the data management are relevant to mention? (use up to 700 characters)

NA

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DPIA

DPIA

Have you performed a DPIA for the personal data processing activities for this project?

- Not applicable

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GDPR

GDPR

Have you registered personal data processing activities for this project?

- Not applicable