

ASSURANCE : "Distributed Sparse Models for Machine Learning in Telecommunications"

Description: The purpose of this research proposal is to develop models as well as training strategies and algorithms for ML, that apply both to classification as well as to regression in a unified way. Thus, although our emphasis is on Signal Processing, the algorithms to be developed can be used in any related ML task. Our approach will incorporate, in the stage of training, all the previously mentioned characteristics that a modern ML system is required to possess, by more carefully "listening" on how human intelligence operates. More specifically, our methodology and algorithmic framework will be developed so that:

- a) to be online and time *adaptive*, in order to be able to track variations of the statistics of the environment,
- b) to incorporate a-priori knowledge in the form of *constraints*,
- c) to operate in a *distributed* learning environment, where a number of nodes exchange information,
- d) to be *sparsity-aware* with respect to the structure of the target system's model and be able to incorporate this information in an efficient way,
- e) to be able to accommodate *non-linear* models in a computationally efficient manner.

Non-linearity is also another feature of the involved processing in the human brain. Controlled non-linearity can drastically improve performance in many practical systems, at the expense of higher computational complexity. **Keywords:** Machine learning, sparse models, distributed systems, telecommunications

Material and Results:

Presentations and work conducted by AUA (Harris Georgiou):

1. **Brain Signals & Sparsity: Update on current state-of-the-art of EEG& fMRI processing with sparsity-aware methods** (Athens, GREECE, Feb.2013).

<http://dx.doi.org/10.5281/zenodo.59608> [download: [pdf](#)]

Technical reports co-authored by CTI/UoA (Harris Georgiou):

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Software and Datasets:

There are several currently running code & data development side-projects linked with the main ASSURANCE project. These are some of the resources I have personally developed and can

ASSURANCE: Material and Results

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publish here as-is (read the licensing info included). Please note that these resources are under continuous development and updates (beta versions), so some features may not yet be fully implemented or stable.

- [fMRI-Sparse toolbox \(Matlab\)](#) : Currently under development, a minimalistic collection of low-level data handling (matrix) functions for fMRI processing, block-based & event-based test pattern series, as well as "realistic" simulated fMRI data series for algorithm benchmarking, template scripts for various fMRI decomposition methods (GLM, PCA, ICA, BP, ...), analysis of components & activation maps, etc. Some features are not yet fully implemented. For detailed info and downloads [see main page](#) .



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