Postdoc- Graph optimization for massive random access

Place: INRIA, Campus de Beaulieu, 35042 Rennes, France (about 12 months)
IMT Atlantique, 655 Avenue du Technopôle, 29200 Plouzané, France (about 6 months)

Supervisors: **at Inria, Rennes**

- Thomas MAUGEY (thomas.maugey@inria.fr)
- Aline ROUMY (aline.roumy@inria.fr)

At IMT Atlantique, Brest

- Elsa DUPRAZ (elsa.dupraz@imt-atlantique.fr)

Goal The goal of the project is to develop the mathematical and algorithmic tools for Interactive communication, where for the case of video, the user can freely switch between several proposed streams (e.g. different views of the scene, replay etc.).

Context The position is funded by the InterCom project[1] that aims to develop novel compression techniques allowing Massive Random Access (MRA) to large databases. We consider a database of multimedia content that is so large that the data has to be compressed efficiently in order to be stored in a single server. Storage efficiency is achieved by compressing jointly all the data items in order to entirely eliminate the redundancies in the database. The stored dataset is then made available to users who may want to access only a subset of the data. The users' requests are considered to be random since the choice of the subset is user-dependent. The requests are further assumed to be massive, meaning that, upon request, the server can only perform low complexity operations (such as bit extraction in the compressed bitstream but no decompression/compression).

The goal of the theoretical analysis is to determine the **minimum storage rate** at the server and the **minimum transmission rate** that should be used to send the data from the server to the client.

Algorithms for two emerging applications of this problem are currently being developed: Free-viewpoint Television (FTV) and massive requests to a database collecting data from a large-scale sensor network (such as Smart Cities).

Envisaged approach In [2], we introduced a graph to model the navigation of the users within the dataset. More precisely, the sequence of requests (called a navigation) of a user corresponds to a path in the graph. In all our previous work [1,2], we assumed that the graph was fixed and resulted from practical constraints. For instance, in FTV, a user can only switch between neighboring views [4,5,6]. However, we also realized that the graph is a new degree of freedom that can be optimized. In particular, we observed that the graph manages the tradeoff between the storage rate and the transmission rate. For instance, a fully connected graph is optimal for the transmission rate, but very inefficient for the storage rate. A minimum spanning tree instead, is optimal for storage, but inefficient in terms of transmission.
The research question tackled is the optimization of the graph to manage the tradeoff between storage and transmission rates and offer a smooth interactive experience for the user.

[1] http://www.intercom.cominlabs.ueb.eu/

International collaboration The project will be developed in collaboration with Pascal Frossard[2], EPFL.

Candidate profile The candidate should have
• strong background in optimization, signal processing,
• notions of source and channel coding, information theory and graph theory would be appreciated,
• interest in programming.

How to apply Each application should consist of
(1) a CV,
(2) a letter of introduction
(3) a copy of the student's university transcripts.
(PDF format would be appreciated).

In the letter, the applicant should include the following details:
• An explanation of his/her interest in the research we conduct and why he/she believes he/she is suitable for the position.
• Details of any relevant work experience (if applicable).

Applications should be submitted by email to Thomas.Maugey AT inria.fr Aline.Roumy AT inria.fr elsa.dupraz AT imt-atlantique.fr with the subject line "**PostDoc graph intercom**" ***as soon as possible***.

Bibliography

[1] A. Roumy and T. Maugey, Universal lossless coding with random user access: the cost of interactivity," in Proc. IEEE Int. Conf. on Image Processing, Quebec, Canada, Sep. 2015. Top 10% best papers.
[2] Elsa Dupraz, Thomas Maugey, Aline Roumy, and Michel Kieffer, "Transmission and Storage Rates for Sequential Massive Random Access," Submitted to IEEE Trans. on Information Theory, https://arxiv.org/abs/1612.07163
[4] T. Maugey and P. Frossard, Interactive multiview video system with low decoding complexity," in Proc. IEEE Int. Conf. on Image Processing, Bruxelles, Belgium, Sep. 2011.
[5] T. Maugey and P. Frossard, Interactive multiview video system with low complexity 2d look around at decoder," IEEE Trans. on Multimedia, vol. 15, pp. 1-13, Aug. 2013.
[6] T. Maugey, I. Daribo, G. Cheung, and P. Frossard, Navigation domain representation for interactive multiview imaging," IEEE Trans. on Image Proc., vol. 22, no. 9, pp. 3459{3472, Sep. 2013.

[2] http://lts4.epfl.ch/frossard