PhD Proposal : Source Coding for Free Viewpoint Television

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The PhD is funded by a Labex CominLabs scholarship and is expected to start in October 2016, for a period of three years. The PhD will be part of the CominLabs project "InterCom", with partners at INRIA Rennes, Telecom Bretagne, and L2S (CentraleSupélec and University Paris Sud). The PhD candidate will be based at Telecom Bretagne, but he/she will have regular contacts with the other partners through meetings and collaborative work.

I. Context

With Free Viewpoint Television (FTV), a user will be able to change the viewpoint of the video he is watching. For example, during a football game, the user may switch from a view at the halfway line to a view beyond the goal (see https://www.youtube.com/watch?v=KrmbMHJQ_u4 for an example). FTV was recently proposed as an alternative to three dimensional television (3DTV), because the number of 3DTV users has recently started to decrease due to visual fatigue experienced by users.

With FTV, the views are stored on a remote server, and the television sends requests to the server, that correspond to the successive views the user wants to receive. FTV involves a huge amount of data (about 120 Gbps for a video with 100 views), and the interaction between the server and the user leads to two compression issues. First, the different views of a video show in general important redundancies, and the *storage cost* may be decreased by jointly compressing all the views. Second, in order to minimize the *transmission cost*, the server should not send all the views, but only the one requested by the user. Unfortunately, no standard compression algorithm (MPEG, HEVC, etc.) allows to extract one single view from a set of jointly compressed views, without having to decode the whole set of data.

II. Motivations and Expected Work

Compared to standard compression algorithms, Aline Roumy and Thomas Maugey, our collaborators at INRIA Rennes, obtained much more optimistic results for FTV. They derived information theoretic bounds which show that it is actually possible both to jointly compress all the data and to transmit only the view requested by the user [RM15]. They also proposed a novel compression algorithm which is based on rate-compatible error correcting codes [ZMZ$^+$12]. These codes enable to adapt the transmission rate depending on the view requested by the user. With this solution, it is possible to both minimize the storage cost by jointly compressing the views, and to minimize the transmission cost by sending only the rate needed to decode the view requested by the user.

However, although optimistic, the results obtained in [RM15] are very preliminary. Only lossless compression is considered, and the videos are modeled as sets of correlated views, where each view is individually independent and identically distributed. In this PhD, we will consider lossy source coding and we will assume more realistic video source models that can take into account spatial and temporal dependencies within the successive frames of the video. For the considered models, we will determine whether the results of [RM15] still apply by determining the corresponding information theoretic bounds and by proposing efficient lossy compression algorithms based on error-correction codes.

III. Conditions of Application

The candidate should have a strong background in mathematics, information theory, and signal processing.

To apply, please send an email at elsa.dupraz@telecom-bretagne.eu and karine.amis@telecom-bretagne.eu giving motivations for the topic, a full CV, student's university transcripts, recommendation letters or contacts of former teachers/supervisors, MSc project or thesis report (if available).

References

[RM15] A. Roumy and T. Maugey. Universal lossless coding with random user access: the cost of interactivity. In *IEEE International Conference on Image Processing (ICIP)*, 2015. *Among 10% best papers.*

[ZMZ+12] K. Zhang, X. Ma, S. Zhao, B. Bai, and X. Zhang. A new ensemble of rate-compatible LDPC codes. In *IEEE International Symposium on Information Theory Proceedings (ISIT)*, pages 2536–2540. IEEE, 2012.