Title

Offset Cubic Projections for 360-Degree Video Streaming

Host Lab

On the building of IMT Atlantique (formerly known as Telecom Bretagne), in the campus of Beaulieu at Rennes. IMT Atlantique (`https://www.imt-atlantique.fr/`) is a public graduating school (a "*grande école*") in the area of Information Technology.

Team

The IRISA team is Adopnet (`http://www-adopnet.irisa.fr/`). This specific internship is related to the "Content Delivery" axis of the Adopnet team.

Advisors

Gwendal SIMON (`http://perso.telecom-bretagne.eu/gwendalsimon/`) will be the main advisor of this internship. His email is gwendal.simon@imt-atlantique.fr. He is graduated from University Rennes 1 in 2004. During his PhD, he worked at Orange Research Labs. From 2004 to 2006 he was a researcher at Orange Labs. Since 2006, he has been Associate Professor at IMT-Atlantique. He was a visiting researcher at University of Waterloo from September 2011 to September 2012. His research interests include multimedia delivery systems (video and gaming) and network management.

Required or Appreciated Skills

The applicant is expected to have a basic background on geometry (trigonometry) and basic skills in coding (especially any math-oriented programming language). A knowledge on video encoding would be appreciated.

Context of the Internship

Offering high-quality virtual reality immersion by streaming 360-degree videos on the Internet is a challenge. The main problem is that most of the video signal information that is delivered is not displayed. Indeed, the Head-Mounted Displays (HMDs) that are used for immersion show a *viewport*, which represents a small fraction of the whole 360-degree video. Typically, to extract a 4K (3840×2160 pixels) video viewport from the whole 360-degree video, the stream should be at least a 12K (11520×6480 pixels) video, from which most information is ignored by the video player.

A solution researchers are exploring to limit the waste of bandwidth is to prepare and stream 360-degree videos such that their quality is not homogeneous spatially [2, 4–6]. Instead the quality is better at the expected viewport positions than in the rest of the video frame. Two main concepts support this solution: (i) encoding of *quality-variable videos*, and (ii) implementation of *viewport-adaptive streaming*, which is to signal the different quality-variable versions of the video, to predict viewport movements, and to make sure that a given user downloads the quality-variable video such that the quality is maximum at her viewport position.

The preparation of 360-degree videos is done in three steps: (i) Capture in every direction (omnidirectional) the real scene; (ii) Project the spherical visual signal onto

a 2D rectangular map; and (iii) Apply the standard encoding techniques to the 2D rectangular map. To implement quality-variable videos in practice, several options are possible. Facebook has recently implemented a technique where the video emphasis on a specific region of the frame is done during the projection, by applying a projection called *offset cubic* [7].

Detailed Description

The objective of the internship is to study the offset cubic projections when applied to omnidirectional videos. Despite its implementation in Facebook, this projection is still not fully understood. In particular the settings of the projection have not been studied with regards to the Quality of Experience (QoE) of the users. The plan of the internship is as follows:

1. Study the offset cubic projection from a theoretical standpoint by using geometry and discrete algorithms. We aim at providing a theoretical framework to evaluate the undersampling of the different frame areas.

2. Study the effect of the projection on the video encoding by using a software that we have developed. We aim here at emphasizing the effect of the undersampling when applied to a real 360-degree video.

3. Propose a new streaming delivery system, which leverages our recent studies of optimal 360-degree video preparation [3] and a dataset extracted from real users watching 360-degree video [1].

References

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