COURSE PLAN

A critério do professor, não havendo alunos estrangeiros matriculados, a disciplina poderá ser ofertada em língua portuguesa.

1) Identification

**Course:** Selected Topics in Computer Science: video coding (Tópicos Especiais em Computação: codificação de vídeo)

**Workload:** 60 hours-class - 4 credits

**Semester:** 2020.1

**Professor:** José Luís Almada Güntzel

2) Levels

Master and Doctorate

3) Prerequisites

Knowledge of programming, data structures and digital design proved through undergraduate and/or graduate courses successfully followed.

4) Syllabus

Basic concepts of video compression, the hybrid video encoder model: coding steps, state-of-the-art video coding standards and their most relevant features; selected aspects of video coders and decoders implemented in software and in hardware (accelerators).

5) Objectives

**General:**

Present an overview of digital video compression flow at the light of the state-of-the-art video coding standards and provide the possibility of understanding one coding step in more details by means of a hardware or software implementation.

**Specific:**

- Present the basic concepts related to the video compression area;
- Present and analyze the most important coding tools used in the block-based hybrid video encoder model;
- Understand the most relevant specificities and differences between some of the state-of-the-art video coding standards;
- Study specific features of coders and decoders implemented in software and in hardware;
- Allow students to go into the details of a coding step by implementing an algorithm or a technique in software or in hardware.

6) Course Outline

Part 1: The block-based hybrid video encoder model:

- Basic concepts: color space, redundancy of information, rate, distortion, block partitioning, frame hierarchy, encoding evaluation metrics, and encoder flow overview;
- Prediction: intra prediction, inter prediction, motion estimation;
- Transform and Quantization: DCT, DST, KLT and respective inverses;
- Quantization parameter;
- Entropy coding: CABAC, CAVLC

Part 2: State-of-the-art video coding standards and their most relevant features:
- Advanced Video Coding (AVC)
- High-Efficiency Video Coding (HEVC);
- Versatile Video Coding (VVC);
- AOMedia Video Codec (AV1);
- Essential Video Coding (EVC).

Part 3: Selected aspects of video coding implementation:
- The Common test conditions;
- Complexity-, QP- and Rate-constrained encoding;
- Rate-distortion tradeoff, coding efficiency vs. energy tradeoff;
- Dedicated hardware implementation;

7) Assessment and Grading

The assessment instruments are:
- Two seminars on topics selected from the course outline (grades S1 and S2)
- Project:
  - Specification (grade Spec)
  - Implementation (grade Imp)

The final grade (G) will be computed as:

\[ G = 0.3 \times S1 + 0.3 \times S2 + 0.1 \times \text{Spec} + 0.3 \times \text{Imp} \]

8) Schedule
To be announced in the beginning of the semester.

9) Bibliography


10) Complementary Bibliography


