COURSE PLAN

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

1) Identification
   - **Course name:** Selected Topics in Computer Science: video coding (Tópicos Especiais em Computação: codificação de vídeo)
   - **Course code:** INE410141
   - **Workload:** 60 hours-class - 4 credits
   - **Semester:** 2020.1
   - **Instructor:** Prof. 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);
- Essencial 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) Methodology

Due to the Covid-19 emergency, the course methodology has been adapted, in agreement with UFSC Resolution 140/CUn/2020. In this way, there will be two types of activities: synchronous and asynchronous.

The asynchronous activities correspond to the development of a practical work (PW) that involves the identification of a problem in the domain of video compression, the proposal of a solution and its implementation and validation.

The synchronous activities correspond to on-line classes to occur during the course hours, on Wednesdays, from 9:00 a.m. to 11:00 a.m., and will be carried out either through the Mconf tool or through the Google Meets tool. They will encompass discussions on the topics listed in section 6 and on the development of the practical works as well.

All course material (slides, papers and links to other materials) will be made available to the students in the Moodle page.

8) Assessment and Grading

The assessment instruments are:
- A grade for the report of the practical work (PWRep);
- A grade for the presentation of the practical work (PWPres);
- The grade for participation (P) in the discussions during the on-line classes.

The final grade (G) will be computed as:

\[ G = 0.4 \times P + 0.3 \times PWRep + 0.3 \times PWPres \]

9) Schedule

To be announced in the beginning of the semester.

10) Bibliography


11) Complementary Bibliography


