AUDIOVISUAL COMMUNICATIONS

Fernando Pereira
Relation and Logistics
Nothing great was ever achieved without enthusiasm.

Ralph Waldo Emerson
US essayist & poet (1803 - 1882)
Web Page and Mailing List

http:\www.img.lx.it.pt\~fp\cav\Welcome_CAV.htm

To subscribe the course mailing list send a message to fp@lx.it.pt

Mailing list address: CAV_MEEC@lx.it.pt
Lectures Schedule

**Theoretical Lectures**

- 2 lectures of 90 minutes per week – Monday, 9.30am, room EA3 and Wednesday, 11am, room EA4

**Practical Lectures (in weeks with no lab)**

- 1 lecture of 90 min per week – Monday, 2pm, room E3 and Wednesday, 9.30am, room E3

**Laboratory Sessions (in weeks with no practical)**

- 1 lecture of 90 min per week – Monday, 2pm and Wednesday, 9.30am, always room LT4

*The weeks with practical lectures or lab sessions will be announced in the CAV mailing list.*
Studying material made available consists in:

- Book “Comunicações Audiovisuais: Tecnologias, Normas e Aplicações”, IST Press, 2009 (details at the CAV Web Page)

- Slides from theoretical lectures (available at CAV Web Page)

- Additional supporting texts for each topic (available at the CAV Web Page)

- Collection of exercises with the corresponding solutions (available at CAV Web Page)

- Laboratory guides (available at CAV Web Page)

- Exams from previous years with solutions (available at CAV Web Page)
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*Note: The book authors gave up on any royalties to reduce the price of the book.*
The CAV evaluation method includes three components, notably:

1. **FINAL WRITTEN EXAM** held after the end of the lecturing period (weight 70%) – 9th and 30th January 2013;

2. **SCIENTIFIC DIVULGATION PAPER** (in groups of 2 or 3) about a selected topic, to provide until 21st December 2012 (weight 30%);

3. **LABORATORY PARTICIPATION** (in groups of 2) to be checked through the filling of a form during the laboratory session.

The final mark is computed by:

\[
\text{Final\_Mark} = \text{round} \left[ (0.7 \times \text{Exam} + 0.3 \times \text{Paper}) \times \text{Lab} \right]
\]

where \(\text{Lab}\) is 1 if the student participated in, at least, \(N-1\) out of the \(N\) lab sessions, and 0.95 otherwise.
Evaluation Method: Some Rules …

★ Exam

- The minimum mark for the exam is 9.5.

★ Scientific Divulgation paper

- The minimum mark for the divulgation paper is 9.5.
- The divulgation paper should be written in groups of 2 or 3 students.
- The divulgation paper mark is individual even if the paper is a group work.
- The evaluation of the divulgation paper may include a self-assessment component.
- The evaluation of the divulgation paper may include a presentation and/or discussion if found necessary.

★ Final mark

- The students with a final mark higher than 17 may have to make an oral exam to confirm the mark; not making this oral exam, if requested, implies getting a mark of 17.
Evaluation Method: Paper Self-Assessment

- By the paper deadline date, each student (not each paper) will provide to a previously identified student representative, his/her ‘estimate’ of the mark for his/her paper. The professor will have NO access to these ‘score estimates’.

- The professor will score the papers in a 0-20 scale.

- The students which estimated mark is **the same** as the professor’s mark will get a bonus of 1 point in the paper mark.

- The students which estimated mark is **± 1 point** regarding the professor’s mark will get a bonus of 0.5 point in the final paper mark.
About the Divulgation Paper

- The divulgation paper consists in a tutorial text about a relevant topic related to audiovisual communications.

- This paper has the target to stimulate in the students the contact with bibliographical research and also with the reality including relevant companies and industry.

- The paper will be produced in two versions:
  1. **Paper version** which shall not have more than 8 PAGES using the template made available at the CAV Web Page.
  2. **HTML version** with a similar content of the paper version but exploiting HTML capabilities typical of Web content, e.g. including video and audio material and interactivity.

For 2012/2013, the deadline for the divulgation paper is 21st December 2012 (Friday).
Divulgation Paper Example Topics

- Aquisição e visualização de imagem
- Codificação de áudio: a guerra dos formatos
- Codificação de música
- MP3 versus AAC
- Codificação de vídeo: a guerra dos formatos
- Descrição e procura de informação visual
- Descrição e procura de música
- Digital Video Disc
- Blu-ray
- iPhone
- iPod
- Tablets
- YouTube
- Protecção de conteúdos multimédia

- Videotelefoneia e videoconferência
- Sistemas de videoguigilância
- Digital Video Broadcasting
- Televisão interactiva
- TV digital em Portugal: comparação das alternativas
- TV digital terrestre
- IPTV
- Vídeo de alta definição
- Vídeo na Internet
- Video on demand
- …
Today at 2pm and also Wednesday at 9.30am (both room E3)!

Students should request a paper topic by sending a message to fp@lx.it.pt with the topic and the names and numbers of the students.
Lab Registration

Send message to fp@lx.it.pt choosing between Monday, 2pm and Wednesday, 9.30am with (2 names+numbers)/group.

Lab session assignment is by order of request!

Audiovisual Communication, Fernando Pereira, 2012/2013
The Context
Audiovisual Communications

Transference of image, audio and video information through space, time, or space and time simultaneously.
The Importance of the User ...
We All Communicate …
Sensations, Perceptions and Emotions …
Communicating Since a Long Time Ago ...
And After Telecommunicating …
What do the Users Want?

- Information
- Entertainment
- Communication
- Games
- Education
- Shopping
- ...

Audiovisual Communication, Fernando Pereira, 2012/2013
How can Clients be Convinced?

- Satisfaction of personal needs
- Added value, new capabilities
- Interoperability
- Quality and robustness
- Content variety
- (Low) cost of equipment and usage
- Easy usage
- ...

Audiovisual Communication, Fernando Pereira, 2012/2013
Satisfaction: Quality versus Service

The minimum required quality of service depends on the service in question:

- Digital imaging (bi-level, grey or colour)
- Analogue TV
- Videotelephony
- Videoconference
- Digital television
- High definition digital television
Quality? What Quality?

★ What does ‘quality’ mean? What is and what determines ‘good quality’?

★ YouTube video and audio quality are sometimes quite poor … but improving fast … still, this does not prevent some of this content to be very popular …

★ Which are the components determining quality?

● Signal fidelity
● User profile and needs
● User involvement
● Context, e.g. train, abroad
● Natural environment, e.g. noisy, dark
● …
Service Paradigms: (Conventional) Broadcasting

- Unidirectional
- Point to multipoint
- Real-time or not
- Low delay but not critical
- High quality
- Generic content
- Centralized content production model
- Several channels and networks
- …
Service Paradigms: Interactive Broadcasting

- Bidirectional but asymmetric
- Point to multipoint and point to point
- Real-time or not
- Critical reaction delay
- High quality
- Generic content
- Centralized content production model
- Several channels and networks
- ...
Service Paradigms: Storage

- Local, no transmission
- High storage capacity
- Very high quality
- Low delay
- Generic content
- Centralized content production model
- Mainly optical storage
- …
Service Paradigms: Personal Communications

- Bidirectional and symmetric
- Point to point
- Real-time
- Critical delay
- Low or medium quality
- Specific content
- Several channels and networks
- …
Service Paradigms: Games

- Storage (or bidirectional)
- Point to point (or multipoint)
- Real-time
- Critical delay
- High quality/realism
- Synthetic and natural content mix
- Centralized content production model
- Mainly optical storage
- …
Service Paradigms: Monocasting Sharing

- Bidirectional but asymmetric
- Downloading and streaming
- Point to point
- Real-time (down) and no real-time (up)
- Critical delay
- Large range of qualities
- Distributed content production model (prosuming)
- Sharing approach
- Social networking
- Several channels and networks
The Contents
Non scholae, sed vitae discimus

We do not learn for the school, but for life

Seneca
Program: an Evolutive Perspective

Stone Age

Bronze Age

Iron Age

Dark Age

Modern Age

Computer Age
Program: a Summary

1. Introduction on Audiovisual Communications
2. Basics on Digital Audiovisual Representation
3. Digital Audiovisual Communication Systems
   3.1 Bilevel imaging
   3.2 Photographic imaging
   3.3 Videotelephony and videoconference
   3.4 Digital video storage
   3.5 Digital television
   3.6 Advanced audiovisual communication systems
   3.7 3D video systems
An Analogue World …
The World Up Side Down ...

Audiovisual Communication, Fernando Pereira, 2012/2013
The World is Made of Change...
Bit Jumping …
Many, Really Many, Bits …

- **Speech** – 2×4000 samples/s with 8 bit/sample – 64000 bit/s = 64 kbit/s

- **Music** – 2×22000 samples/s with 16 bit/sample – 704000 bit/s = 704 kbit/s

- **Video** – (576×720+2×576×360)×25 (20736000) samples/s with 8 bit/sample – 166000000 bit/s = 166 Mbit/s

- **Full HD 1080p** - (1080×1920+2×1080×960)×25 (103680000) samples/s with 8 bit/sample – 829440000 bit/s = 830 Mbit/s

Audiovisual Communication, Fernando Pereira, 2012/2013
We Need a Miracle!
Digital TV: Only an Example

* ITU-R 601 standard: 25 images/s with $720 \times 576$ luminance samples and $360 \times 576$ samples for each chrominance, at 8 bit/sample

$$[(720 \times 576) + 2 \times (360 \times 576)] \times 8 \times 25 = 166 \text{ Mbit/s}$$

* Practical bitrate with H.264/MPEG-4 AVC codec: 2 Mbit/s

=> Required Compression Factor: $166/2 \approx 80$

The difference between coding or not implies the existence or not of many largely used services.
The Coding Miracle …

Encoder

Decoder

Non Compressed Bits

Compressed Bits

Much less bits !!!
The Consequences of the Miracle (1) ...
The Consequences of the Miracle (2) …
The Multimedia Babel Tower …

4 billion (June 2009)
- ~4000 uploads/minute
- 128 years to view all of them (1s per image)
- 2% Internet users visit
- Daily time on site: 4.7 minutes

120 million (July 2009)
- ~20 hours uploaded/minute
- 600 years to see all of them
- 20% Internet users visit
- Daily time on site: 23 minutes

15 billion (April 2009)
- ~22000 uploads/minute
- 480 years to view all of them (1s per image)
- 24% Internet users visit
- Daily time on site: 30 minutes
From Hunger to Plenty or Drowning in Data ...
Filtering TV ...
Managing iPods Data ...

![Image of an iPod](image1)

- Can't Get It Out of My Head
  Greatest Hits - Electric Light Orchestra
- The Things We Do For Love
  Greatest Hits 1972-76 - 10cc
- I Wouldn't Want To Be Like You
  I Robot - Alan Parsons Project
- Rikki Don't Lose That Number
  A Decade Of Steely Dan - Steely Dan
- Take the Long Way Home
  The Very Best of Supertramp - Supertramp
- Nights on Broadway
  Their Greatest Hits - The Record (Disk 1) - Be...
- Your Mama Don't Dance
  The Best Of Friends - Loggins & Messina

Audiovisual Communication, Fernando Pereira, 2012/2013
Data and Metadata Make a Great Couple ...
Digital is Easy: The Piracy Effect
Patents and Copyright …

Intellectual property (IP) enjoys legal protection and stems from the exercise of the mind. IP regards patents, trademarks, copyright, design protection and some minor rights.

- A patent for an invention is granted to the applicant, and gives him the right for a limited period to stop others from making, using or selling the invention without permission.

- Copyright is a legal right (usually of the author or composer or publisher of a work) to exclusive publication production, sale, distribution of some work.
A business model is the method of doing business by which a product/service can sustain itself - that is, generate revenue.

Some business models are quite simple. Other models can be more complex such as free television. The broadcaster is part of a complex network of distributors, content creators, advertisers, and listeners or viewers. Who makes money and how much is not always clear at the outset.

- Digital representations and networks give rise to new kinds of business models, since acquiring, transmitting, and storing information (now just bits) became much easier.

- But it is also likely to reinvent ‘old’ models such as auctions. New and interesting variations of old models should be expected in the future.
iPod may play the following audio formats: MP3, WAV, AAC, Protected AAC, AIFF and Apple Lossless.
About Forecasting …

This TV ad about flat screens appeared in 1945 in an English newspaper!

Advices about forecasting:

- You may try to forecast ‘WHAT’ …
- But never try to forecast ‘WHEN’ …
Multimedia in Portugal

* It is today much easier than before to create and sell audiovisual communication related products (mainly software based).

* Internet helps the success of small, innovative companies created without much investment.

* The competition between companies may stimulate also the operators to embrace more innovative challenges.

* Users are increasingly open to new services.

* International contact is changing old habits and prejudices …

Moreover, multimedia technology is an interesting field for Portuguese young engineers with initiative to launch their own companies!