TAMPEREEN TEKNILLINEN YLIOPISTO

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VIDEO TESTING IN MOBILE DEVICES

DiplomityÃ¶

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Tämä (*d-tyo.tex*) on LaTeX-pohja Tampereen teknillisen yliopiston opinnäytetöitä varten. Samaan pakettiin kuuluu myös tiedosto *tutthesis.cls*, joka sisältää taittoteknisiä lisäyksiä LaTeX:n alkuperäiseen *report.cls*-luokkatiedostoon.

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TERMIT JA NIIDEN MÄÄRITELMÄT

MSE	Mean Square Error
SNR	Signal to Noise Ratio
HSV	Human Visual System
VQEG	Video Quality Experts Group
DVq	Digital Video Quality
NR	No Reference

1. INTRODUCTION

Every minute there are 100 hours of video uploaded just to Youtube.com. [23]

Analysis, subjective or objective, for video is just starting. In year xx there where xx articles related to video in IEEE explorer but after two year the amount of arcticles has skyrockete and there is no end.

The goal for this thesis is to make state of art analysis of current methods of video testing. I will not study transmission erros over networks. I focus on erros coming from coding, device, optics, ois(optical image stabilization), etc. I try to focus more on non-reference methods but reference video methods are also studied and introduced.

Videos in this thesis are considired as being part of multimedia experience ment for human usage so any medical, traffic and et cetera related usage has been ruled out of scope. Medical videos has more strict rules for example in compression to be lossless and in traffic the ROI, region of interest, can be the only the license plate to verify the owner of the vehicle. In human usage it is more about the whole experience and seameless image stream without any clitches, sound-sync error is the most important part of viewing videos. ls

Video quality can be determined with psychophysical experiments, but they are expensive and time consuming to arrange. There are no physical measure like meter for distance to predict the quality of video.

On first chapter I will define what is mobile device. What restrictions it causes in testing and typical ways of mobile testing.

Second chapter will introduce dirrerent error types divided into algorithmic and harware related errors. This will help us to understand how to recognize those errors and also how to detect those in testing and how to correct them.

Third chapter digs in to the state of the art of testing methods: subjective, objective, reference, non-reference, black box and etc.

Fourth chapter shows comparision of different methods or practical example done with matlab.

Fifth chapter is for conclusions and future work.

2. MOBILE DEVICE

In this chapter I will go trough basic features in video and imaging sense of mobile devices. I will also try to define what is mobile device to give some kind of limitations what kind of errors are to be handled and what is the boundary line for example sensor size and stuff

2.1 What is mobile device

2.1.1 Restrictions of mobile device

2.2 Mobile device testing

2.2.1 Driver level

2.2.2 Middleware

2.2.3 User Interface

2.2.4

3. THEORY OF VIDEO TESTING

In this chapter error sources are introduced because before we can start testing errors in video we must understand where and why are the erros generated. That will also help developing test methods but also understanding results and actions followed by them.

I have diveded erros in the algroritmic and hardware based errors. Main focus will be on the algorithmic errors, but essential hardware errors like noise are also introduced. Some errors have overlapping reasons like in example jitter might be caused by poor processor performance or error in algrorithm design. Those are handled by the most dominant reason base. So ie.*noise* is categorized as hardware error, but *jitter* is handled in algrotihm side.

Errors produced in transmission like in videocalls, over network streaming, watching videos from www.youtube.com are not dealt with in this thesis.

3.1 Algorithmic errors

Algorithms include: –Exposure –White Balance –Focus –Coding/Encoding —Many things in here

3.1.1 Blockiness

-Fixed framerate vs. non fixed framerate -Too low bitstream -how it is seen

3.1.2 Blurr

-shutter speed -Fixed framerate vs. non fixed framerate

3.1.3 Blink

-Exposure jumping

3.1.4 Motion smoothness

3.1.5 Jaggy edge

-bitsteam, codec -how it is seen/detected

3.1.6 Frame drop

-Jitter -Jerkiness

3.1.7 Sound Sync

-

3.1.8 Moiré-effect

3.1.9 Aliasing

3.2 Hardware erros

3.2.1 Noise

Noise

Temporal noise sources

-Reset noise -Thermal noise -1/f noise -dark current shot noise -quantization noise -phase noise

Spatial noise sources

-dark fixed-pattern noise -PRNU -leakers -defect pixels -cosmetic defects

3.2.2 Frame drop

-also SW error

3.2.3 Jellyness

-Ois and corners

3.2.4 CMOS and CCD sensor

-Noise from sensors –Temporal noise -Rolling shutter –Wobble –Skew –Smear –Partial exposure

Testing citing [5]

addign cites to get them visible in the end [9] [22] [10] [1] [12] [21] [18] [20] [13] [15] [17] [6] [11] [2] [19] [14] [3] [8] [4]

4. DIFFERENT TESTING METHODS

4.1 State of art in Video testing

Most widely used methods are PSNR and MSE [4] Benefits *Easy to calculate, easy to compare Minuses *Correlation with visible erros low sometimes

4.1.1 Reference testing

4.1.2 Non-Reference testing

TODO: find more watermark based studies and compare them ie: "A no-reference vodeo quality assesment method based on digital watermarking" Model where watermark is added to video and the idea is that after the video os gone trough the modification pipeline(algorithms, compressions etc) that once the watermark is extracted from result video the degeneration is about the same that it would be for the actual video. [2]

4.1.3 Objective testing

Definition for objective testing is ...

At least three different methods are mentioned on many articles and studies all along. PSNR, SSIM and VQM create to cornerstone for objective testing. cite4800123. They all try to evalute quality of saved/received video, but with differents means in mathematical complexity and therefore the results also vary when compared to Subjective methods

PSNR and MSE -is the most commomnly used at least in the literature. -Why not in real solutions -Easy to calculate, remember five formulas and some example in calulation time -Correlation with subj. methods quite ppor SSIM -At least available to MatLAb quite complex -Complex to calculate -Fairly good correlation with sub. methods VQM -The harderst to calculate -Not available -Why not? -Good correlation with subj. methods.

Comparsion/conclusion of objective methods

ftp://ftp.cs.wpi.edu/pub/techreports/pdf/06-02.pdf

[4]

4.1.4 Subjective testing

http://www.its.bldrdoc.gov/resources/video-quality-research/standards/objective-models.aspx
This is the main thingy also other can be used for ie. [7]
Human visual system *Spatial response *Temporal response *Masking [4]
The history of video quality model validation [16]

5. PRACTICAL EXAMPLE OR COMPARISION OF METHODS

Here we might have some kind of practical example or comparasion of state of the art methods

5.1 Foo Bar

6. CONCLUSIONS AND FUTURE WORK

And here we have the grand conclusions. What ever they might be.

KIRJALLISUUTTA

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A. LIITTEITÃ