原 流媒体视频质量评价(单刺激连续质量评价方法)

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Stefan Winkler等人在论文《Video Quality Evaluation for Internet Streaming Applications》中,介绍了流媒体视频质量评价的方法,以及他们的研究结果,在此记录一下。

注:本文中使用了单刺激连续质量评价方法(SSCQE),很有参考价值。

参与测试的序列如下表所示。注:这些序列可真是够长的!

表1是流媒体 (Streaming) 格式 (360x288)

 $\textbf{Table 1}. \ \ \text{Scenes for streaming content (360} \times 288, 25 \text{fps)}; \ \ \text{duration in seconds:} frames$

Scene #	Description	<u>→</u>	
A	Letters		
В	News	Male and female speaker in newsroom, almost still	11:23
C	F1 car	Object motion, camera following car, 2 angles	8:20
D	Fast food	Texture, people, fast pans, 2 angles	8:20
E	Coastguard	Two boats crossing on river, medium motion, water motion	11:24
F	Balloons	Amusement park, saturated colors, people, motion	8:05
G	Foreman	Talking head, with pan to construction site, geometric shapes	16:00
H	New York	Slow city flyover, skyscrapers at sunset, detailed texture	10:10
I	Football	Fast camera and object motion, colors	10:10
J	Live concert	Dark scene, spotlights, 3 angles	13:15
K	Cartoon	Characters dancing through scene, with pan n. net/leixiao	12:14

表2是电影 (film) 格式 (844x360)

Table 2. Scenes for film content (844×360, 25fps); duration in seconds:frames

Scene # Description		Characteristics D	
A	Movie credits	Text on forest flyover towards city skyline	15:03
В	City street	Man leaving shop, walking around building, detail, camera pan	12:01
C	Action	Helicopter crashing into building, explosion, 3 angles	9:12
D	Country road	Camera on car following road, 2 angles	6:17
E	Casino outdoors	Car driving up to casino at night, camera pan, object motion, detail	9:22
F	Casino indoors	People passing through hall, camera follows them	9:22
G	Bridge	Pan to two people crossing bridge, faces	22:12
H	Dinner	Woman talking at dinner table, faces	7:18
I	Living room	Woman in red dress walking down stairs and across room, camera follows her	10:15
J	Desert race	SF race through canyon/desert landscape, several angles	13:02
K	CG movie	Camera pan over characters, very colorful, fade to other scene	11119:14

本实验考虑2种损伤:

- 1.视频压缩损伤
- 2.网络传输损伤

模型如下图所示。



Figure 1. HRC generation chain net/leixiaohua1020

本实验考虑了以下编码方式:

- Windows Media Video 8
- Real Video 8
- ISO MPEG-42 (Microsoft implementation)

实验序列的设置如下表所示。注:PLR,Packet Loss Rate,丢包率。

Table 3. HRC's for medium-size streaming content

HRC #	Codec	Bitrate	PLR
1	WM	256 kb/s	-
2	Real	256 kb/s	-
3	Real	256 kb/s	2%
4	WM	512 kb/s	8=
5	Real	512 kb/s	-
6	Real	512 kb/s	3%
7	MPEG-4	512 kb/s	-

Table 4. HRC's for high-resolution film content

HRC #	Codec	Bitrate	PLR
1	WM	512 kb/s	83
2	Real	512 kb/s	-
3	Real	512 kb/s	4%
4	MPEG-4	512 kb/s	-
5	WM	1 Mb/s	-
6	Real	1 Mb/s	-
7	Real	1 Mb/s	12%
8	MPEG-4	1 Mb/s	8.00

主观质量评价

本实验考虑以下2种主观质量评价方法:

- 1. 单刺激连续质量评价方法(SSCQE,这个方法比较不常见,但是还是挺重要的)
- 2.双刺激损伤标度法(DSIS)

质量评价软件打分模块如下图所示。一个是单刺激的,一个是双刺激的。

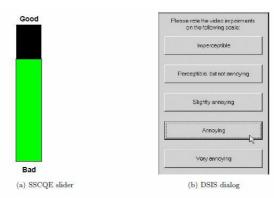


Figure 2. Voting devices designed for the subjective experiments. 1020

实验安排如下图所示。可见实验量还是挺大的。

Table 5. Summary of experiments

Test	Streaming Content	Film Content
SSCQE session	2 sequences (Table 1) 7 HRCs (Table 3) 14 min. of test material (with break at half-time)	2 sequences (Table 2) 8 HRCs (Table 4) 16 min. of test material (with break at half-time)
DSIS session	11 sequences (Table 1) 7 HRCs (Table 3) 28 min. of test material (with break at half-time)	

显示其使用15" Sony SDM-S51。其属性如下表所示。

Resolution:	1024×768
Dot pitch:	0.297 mm
Peak luminance:	250 cd/m^2
Contrast ratio:	300:1
Viewing angles:	120° horizontal, 90° vertical
Response times:	10 ms (rise time), 20 ms (fall time)

校准和黑电平调整后,测得如下屏幕属性:

Gamma:	2.2
Color temperature:	6400 K
White luminance:	77 cd/m^2
Video surround:	20 cd/m^2

实验室设置如下图所示:



htt Figure 3. Laboratory setup leixiaohua1020

一共20个非专家人员(绝大部分是大学生)参加了实验。

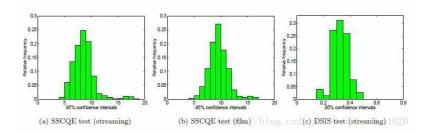
实验数据分析

几种方法的测试区间如下所示:

SSCQE streaming(0-100):8.5

SSCQE film(0-100):9.5

DSIS(0-5):0.33



SSCQE和DSIS之间的关系如下图所示。

该图可以拟合出一个关系式: SSCQE = 18.9×DSIS - 0.9

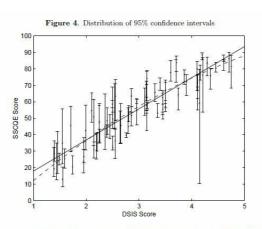


Figure 5. Comparison of DSIS and SSCQE mean scores. The vertical bars indicate the range of SSCQE scores within the corresponding DSIS sequence part; the dots indicate the average over those scores. The solid line represents a linear fit through the data (92% correlation), the dotted line results from a quadratic fit.

SSCQE实验结果如下图所示。横坐标是时间,纵坐标是MOS。灰线外面有一个矩形代表该处有95%的置信区间。

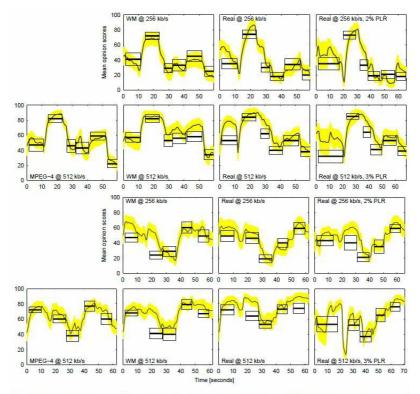


Figure 6. SSCQE ratings (smooth curves) for the 14 streaming test sequences and DSIS ratings (thick line segments) for the corresponding 77 sequence parts. Top two rows: source scenes A_F, bottom two rows: source scenes G_K. The gray bands and the hollow rectangles around the mean values indicate the 95% confidence intervals.

下面两张图显示了编码器比较的结果。横坐标是一种编码器的SSCQE的分数,纵坐标则是另一种编码器的SSCQE的分数。 图7是流媒体内容的对比,字母和表1中的序列的字母是相对应的。小的斜体字母代表256kbps码率的结果。大的粗体字代表512kbps码率的结果。 图8中电影内容的对比,点代表512kbps码率的结果,叉代表1Mbps码率的结果。

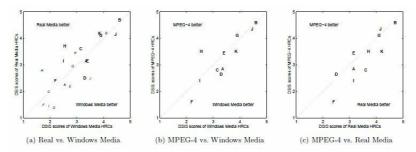


Figure 7. Codec comparisons for streaming content. The letters correspond to the scene numbers from Table 1. Small italic letters denote 256 kb/s HRC's, large bold letters denote 512 kb/s HRC's (only HRC's without packet losses are shown).

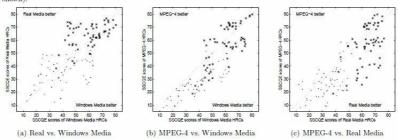


Figure 8. Codec comparisons for film content. 512 kb/s HRC's are represented by dots, 1 Mb/s HRC's are represented by crosses (only HRC's without packet losses are shown).

将本次试验的数据用于Genista's Stream PQoS 软件。得到一个无参考视频质量评价方法。该方法主观和客观之间的关系如下图所示。

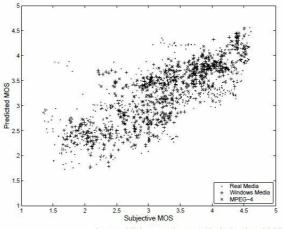


Figure 9. Predicted MOS vs. subjective MOS (both mapped onto the 1-5 scale).

该方法的性能如下所示。

Table 6. MOS prediction performance

	Linear correlation	Rank-order correlation	Prediction error
Real Media	76%	76%	0.54
Real Media (no PL)	84%	83%	0.48
Windows Media	84%	85%	0.41
MPEG-4	83%	84%	0.36
Overall	78%	79%	0.48

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个人分类: 视频质量评价 所属专栏: 视频质量评价

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