QUALITY ASSESSMENT OF MPEG-4 AVC/H.264 AND HEVC COMPRESSED VIDEO IN A TELEMEDICINE CONTEXT


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General context

Ex. Nancy University Hospital: 55 Tbytes in 2015!!!

Data Compression

Medical image

Medical video

Storage

Local Network

Network

Transmission

Remote consultation

Celtic Plus European project Hipermed

(2010-2013)

Best European project 2014

http://hipermed.eu/

New Celtic Plus European project E3

(2015-2018)

Mobility for high and low bitrate networks

Solutions:

✓ Compress more the medical videos by using the new video encoding standard HEVC.
✓ Evaluate the quality of medical compressed data with respect to their usage

"The best quality for a given constrained bandwidth.

Material & Methods

Goal

Compare performance between AVC/H.264 (x264) and HEVC (x265)

Subjective test environment

✓ Living-lab PROMETEE

(http://prometee.telecomnancy.eu/)
✓ ITU-T.B500-13 protocol
✓ Double Stimulus Continus Quality Scale (DSCQS)
✓ FHD 42” screen
✓ Duration: 2x24minutes

Subjective tests procedure

✓ 5 different AVC/HEVC compression ratios
✓ FHD vs SD resolutions
✓ Mean Opinion Score (MOS)
✓ 16 observers (5 women and 11 men

Experimental Results

FHD encoding: x264 vs x265 quality performance

✓ Evolution of the MOS score with respect to the AVC/HEVC compression bit-rate
✓ “” function
✓ Threshold of quality: MOSmin=0.1

SD vs FullHD quality behavior

SD resolution = FHD at low bit-rate (<096 Mbits/s)!!

Conclusion & Perspectives

✓ HEVC (x265) is more efficient than AVC/H.264 (x264).
Fixing MOS=0.1, the gain at compression bit-rate ranges between 13% and 54% with respect to x264.
We can switch from FHD to SD resolution at low bit-rates (<1Mbits/s).

Future work: to generalize these results to other types of medical video

HEVC offers 50% of bit-rate save with respect to AVC!!

<table>
<thead>
<tr>
<th>Sequence</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>HEVC thresholds (Mbits/s)</td>
<td>4.19</td>
<td>6.53</td>
<td>5</td>
<td>3</td>
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<tr>
<td>AVC thresholds (Mbits/s)</td>
<td>5.15</td>
<td>7.49</td>
<td>7.3</td>
<td>6.5</td>
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</table>

Objective metrics

✓ 16 objective metrics
✓ Pearson correlation assessment coefficient: Linear Correlation Coefficient (LCC).
✓ LCC → 1 → the best correlation between subjective and objective marks.

<table>
<thead>
<tr>
<th>LCC</th>
<th>Avg(AVC)</th>
<th>RK(AVC)</th>
<th>Avg(HEVC)</th>
<th>RK(HEVC)</th>
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<tbody>
<tr>
<td>SSIM</td>
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<tr>
<td>NIQE</td>
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<tr>
<td>NQM</td>
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<td>0.9513</td>
<td>2</td>
</tr>
<tr>
<td>BRISQUE</td>
<td>0.9437</td>
<td>4</td>
<td>0.8263</td>
<td>13</td>
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</tbody>
</table>

✓ MSE: ENT surgeons seem to rather focus on the global video quality during the surgery.
✓ NQM: Human vision is sensitive to the variation of both luminance and contrast.
✓ SSIM/MSSIM: Structural approach.
✓ NIQE/BRISQUE: Effectiveness of the deblocking filter used by HEVC.