Scalable H.264 Video Coding

SIPL's annual project presentation day

Students: Alexander Shamaev
          Gregory Vaksman

Supervisor: Hilla Madar
           Yair Moshe

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Project goals

- Learn the scalability concept
- Learn the standardized scalability extension of H.264/AVC
- Learn the wavelet transforms
- Implementing the wavelet transform by lifting scheme in MATLAB
- Simulate the lifting scheme and MCTF in MATLAB
Scalable coding offers multiple levels of decoding:

- **Base-layer** provides coarse reconstruction
- **Enhancement-layer** improves the quality
Lifting Scheme

![Diagram showing the Lifting Scheme process](image)

- **P** = Prediction
- **U** = Update
- **↓** = Down-sampling
- **↑** = Up-sampling

MCTF is innovative because for Prediction and Update it uses the standard motion estimation of an H.264 encoder.
Analysis Filter Bank

\[ S_{2k} \quad \quad S_{2k+1} \]

\[ L_k \quad \quad H_k \]
Synthesis Filter Bank
Performance with Fast Motion

\[ S_{2k} \quad S_{2k+1} \]

\[ L_k \quad H_k \]
Filter Banks

Two-Stage Two-Band Analysis Tree:
Filter Banks

$L_0 \xrightarrow{L_k} L_1 \xrightarrow{H_k} H_0$

$L_2 \xrightarrow{L_{2k}} L_{2k+1} \xrightarrow{H_{2k+1}} S_{4k+3}$

$L_2 \xrightarrow{H_{2k}} S_{4k+2}$

$L_2 \xrightarrow{H_{2k+1}} S_{4k+1}$

$L_2 \xrightarrow{H_{2k}} S_{4k}$

$L_2 \xrightarrow{H_{2k}} S_{4k+2}$

$L_2 \xrightarrow{H_{2k+1}} S_{4k+3}$
Temporal Decomposition of Frames

Temporal decomposition of input frames into low-pass and high-pass frames:

different resolution ratios
Iterative Temporal Decomposition by MCTF

The red-framed pictures need to be transmitted together with the corresponding motion information.
Conclusion

- For smooth sequences (like “Container”) even after three-stage decomposition we are received Base layer in very good quality.

- For rapid changing sequences (like sign_irene) after two-stage decomposition the quality of the Base layer was quite poor.