UNIFORM EMBEDDING FOR EFFICIENT STEGANOGRAPHY OF H.264 VIDEO
Baolin Zhu, Jiangqun Ni
Guangdong Key Laboratory of Information Security Technology,
Guangzhou 510006, P.R. China
zhubl3@mail2.sysu.edu.cn, issjqi@mail.sysu.edu.cn

Introduction
In our paper, a video steganography scheme – UED_H.264 is proposed by taking into account the several key issues in video steganography, e.g., the MV correlations, the local optimality and the degradation of the reconstructed video frames. Data are embedded in MVs with multi-stage STC appropriately.

The multi-objective optimization

- Uniform Embedding to Maintain the MV Distributions
  The motion vector difference (MVD) is reasonable to evaluate the correlation of the MVs. As MVD has similar distribution with JPEG, UED is adopted to minimize the impact on the MV correlation.
  
  The correlation factor for h:
  \[
  f^h(\Delta_h) = \begin{cases} 
  1 & \text{if } \Delta_h = 0 \\
  0 & \text{otherwise} 
  \end{cases}
  \]
  
  The correlation factor for v:
  \[
  f^v(\Delta_v) = \begin{cases} 
  1 & \text{if } \Delta_v = 0 \\
  0 & \text{otherwise} 
  \end{cases}
  \]

- The Effect on Local Optimality
  As the sum of absolute difference (SAD) and the sum of absolute transform difference (SATD) are no less than 0, if the residual block of the modified MV is quantized to zero, the local optimality will be held.
  
  The local optimal factor for h:
  \[
  f^{l^h}(\Delta_h) = \frac{1}{3} \sum_{i=1}^{16} f_i(\Delta_h, \Delta_v) \]
  
  The local optimal factor for v:
  \[
  f^{l^v}(\Delta_v) = \begin{cases} 
  \frac{1}{16} D(V_{\Delta v}^h) & \text{if } D(V_{\Delta v}^h) < T^h \\
  0 & \text{otherwise} 
  \end{cases}
  \]

- The Degradation of the Reconstructed Frames
  To minimize the degradation of the reconstructed frames, a distortion factor is proposed to evaluate the similarity between the residual blocks.
  
  The local optimal factor for h:
  \[
  f^{l^h}(\Delta_h) = \frac{1}{3} \sum_{i=1}^{16} f_i(\Delta_h, \Delta_v) 
  \]
  
  The local optimal factor for v:
  \[
  f^{l^v}(\Delta_v) = f^v(\Delta_v) \cdot \frac{1}{16} D(V_{\Delta v}^h) 
  \]

- The Overall Distortion Function
  By combining all these factors together, we have the overall distortion function for horizontal component \( h \) and vertical component \( v \) respectively.
  
  The overall distortion function for h:
  \[
  f^h(\Delta_h) = f^h(\Delta_h) \cdot f^{l^h}(\Delta_h) \cdot f^v(\Delta_v) \cdot f^{l^v}(\Delta_v) 
  \]
  
  The overall distortion function for v:
  \[
  f^v(\Delta_v) = f^v(\Delta_v) \cdot f^{l^h}(\Delta_h) \cdot f^v(\Delta_v) \cdot f^{l^v}(\Delta_v) 
  \]