Intra depth-map coding using flexible segmentation, constrained depth modeling modes and simplified/pruned directional prediction

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State-of-the-art

3D-HEVC

- Design for video and depth coding
- It can be used for depth coding only
- Intra directional prediction
- Transform based residual coding
- Depth specific tools
  - Depth modeling modes (DMM)
  - Depth lookup table (DLT)
  - Region boundary chain coding
  - All in-loop filters disable
Predictive Depth Coding

- Flexible Block Partitioning
- Directional Intra Prediction
  - Pre-defined reduction intra direction
  - Adaptive reduction intra direction
- Constrained Depth Modelling Mode
- Non-transform residual signal coding
Flexible Block Partitioning

- Combination of QuadTree and BinTree
  - Quad split (q)
  - Horizontal split (h)
  - Vertical split (v)

- Various block sizes allowed
  - From 64x64
  - Down to 1x1
  - High asymmetry block excluded e.g. 8x64, 1x64
Directional Intra Prediction

- Intra directional prediction from HEVC
  - Planar
  - DC
  - 33 angular
Pre-defined reduction

- In case of
  - small blocks
  - asymmetric blocks
  many directions produce similar prediction signal
- Pre-defined set of directions for every block size
  - Reduced computational complexity
  - Reduced necessary bits

Directions that produce similar prediction

1x4 block
Adaptive reduction

- When all reference samples are exactly the same, many directions produce similar prediction signal.
- Three sets of directions can be disabled depending on:
  - Top and left neighbor samples
    - Disable of modes 10-26
  - Left neighbor samples
    - Disable of modes 2-9
  - Right neighbor samples
    - Disable of modes 27-34

Directions that produce similar prediction
Constrained Depth Modelling Mode

- Similar to DMM in 3D-HEVC
- Designed to represent edges difficult to predict
- Only edges located below anti-diagonal of the block
- Minimal signaling
  - Average depth value of the partition $P_1$ and $P_2$
  - Distance in pixels from anti-diagonal $d$
Constrained Depth Modelling Mode

- Various slopes possible
- Depends on block size
- Exploits flexible partitioning
Residual coding

- DCT not used
- Residual coding depending on prediction mode used
- Null residual or
- Simple linear approximation

Enhanced by DLT as in 3D-HEVC
Experiments

- Compared with 3D-HEVC version 8.2
- All Intra configuration, without VSO
- Only depth maps were coded
- Seven 3D test sequences used (+shark)
- Compared at 4 rate points
- Following evaluation methodology from CTC
  - Virtual views synthesized based on original video and decoder depth maps
Bitrate reduction for depth maps, over 3D-HEVC
Encoder complexity over 3D-HEVC

Execution time ratio (less is better)

avg 0.745
Conclusions

- New intra based depth maps coding algorithm has been developed
- Provide an alternative approach to depth coding
- Provides 3.17% bitrate reduction on average
- 25% less complex than state-of-the-art 3D-HEVC

- Requires further works
  - To support VSO
  - Inter-frame prediction
Questions?