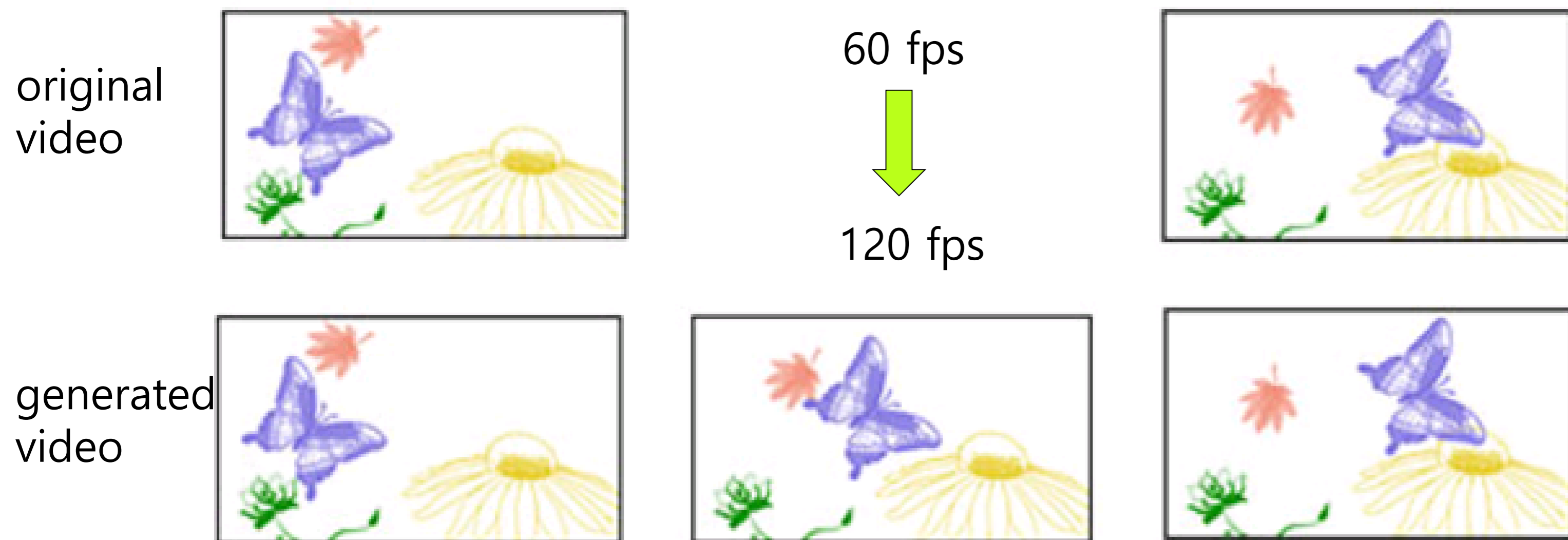# A SEMI-GLOBAL MOTION ESTIMATION OF A REPETITION PATTERN REGION FOR FRAME INTERPOLATION

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## 1. Introduction

### Motion Compensated – Frame Rate up Conversion



original video

60 fps

120 fps

generated video

- MC – FRUC increases frame rate of a video by interpolating a new frame
- MC – FRUC composes two operations:
  - Motion Estimation and Motion Compensated – Frame Interpolation

## 3. Proposed Algorithm

**Step 1: Make MV Histogram of MV candidates**
**1.1. Initialization:** All bins are the MV histogram are empty
**1.2. Build an MV set for each block**
**Core Algorithm**
For (each block k)
   Initialization: MV $Set_k$ = {Empty}
   Loop over search range
   1.2.1. Find a local minimum
   1.2.2. Push the local minimum into the MV $Set_k$ or Not
   if (size_of(MV $Set_k$) < 10)
     push the local minimum into the MV $Set_k$
   else {
     find MAX_VALUE = max(local minima in MV $Set_k$)
     if (the local minimum < MAX_VALUE) {
       remove MAX_VALUE out of MV $Set_k$
       push the local minimum into the MV $Set_k$
     }
   }
**1.3. Check the block is in a repetition region or not**
If (repetition block k)
   Push the motion vectors in the MV $Set_k$ into bins
**Step 2: Choose the representative of the region**
   The most frequent MV candidate in the MV Histogram

## 4. Experimental Results

| Testbeds | Local-based method [2] | | Proposed method |
|---|---|---|---|
| | PSNR (dB) | Δ (dB) | PSNR (dB) |
| Bus | 24.72 | 2.23 | 26.95 |
| Mobile | 26.16 | 0.67 | 26.83 |
| Calendar | 28.80 | 4.86 | 33.66 |
| Average | **26.56** | **2.59** | **29.15** |

## 5. Conclusion

- The first method to adopt a semi-global approach that exploits both local and global properties of repetition pattern regions to estimate motions.
- The proposed method is simple but effective.

## 2. Motivation

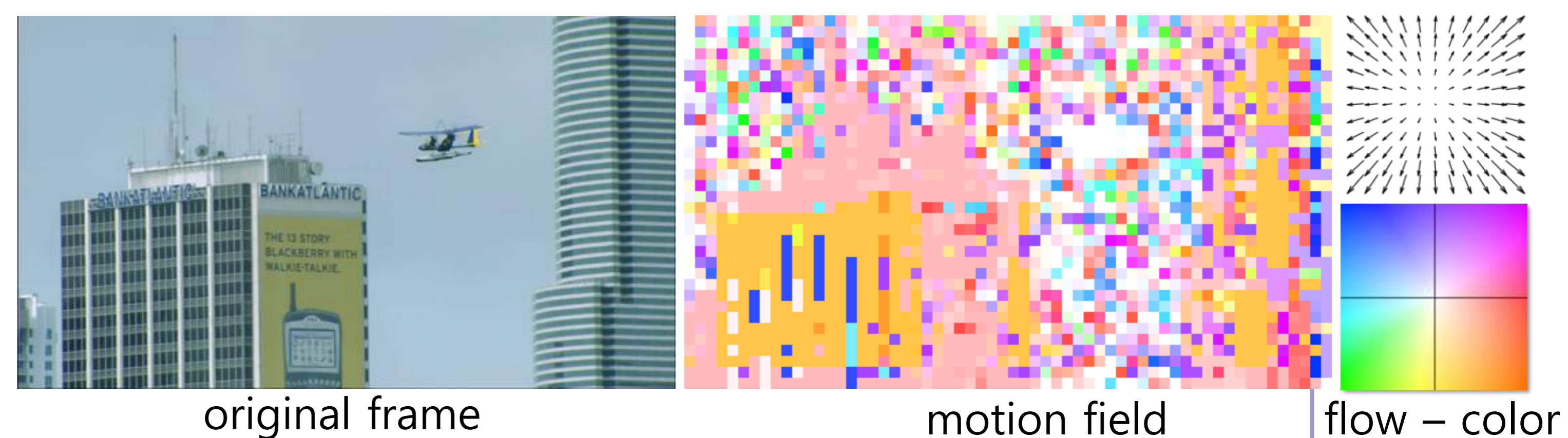### Motion Estimation for Repetition Pattern Regions

- Multiple local minima for Block Matching Algorithm in RPRs
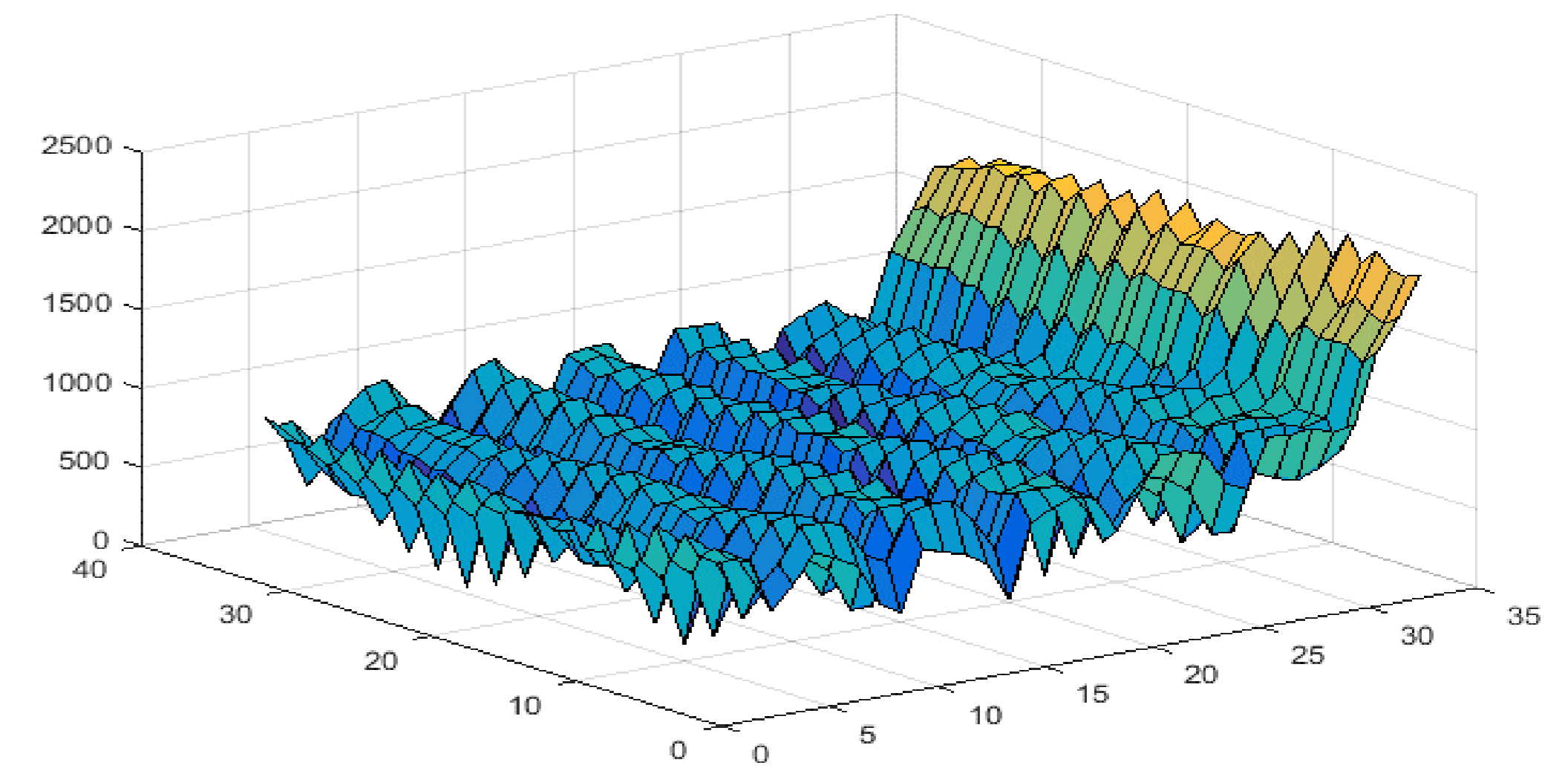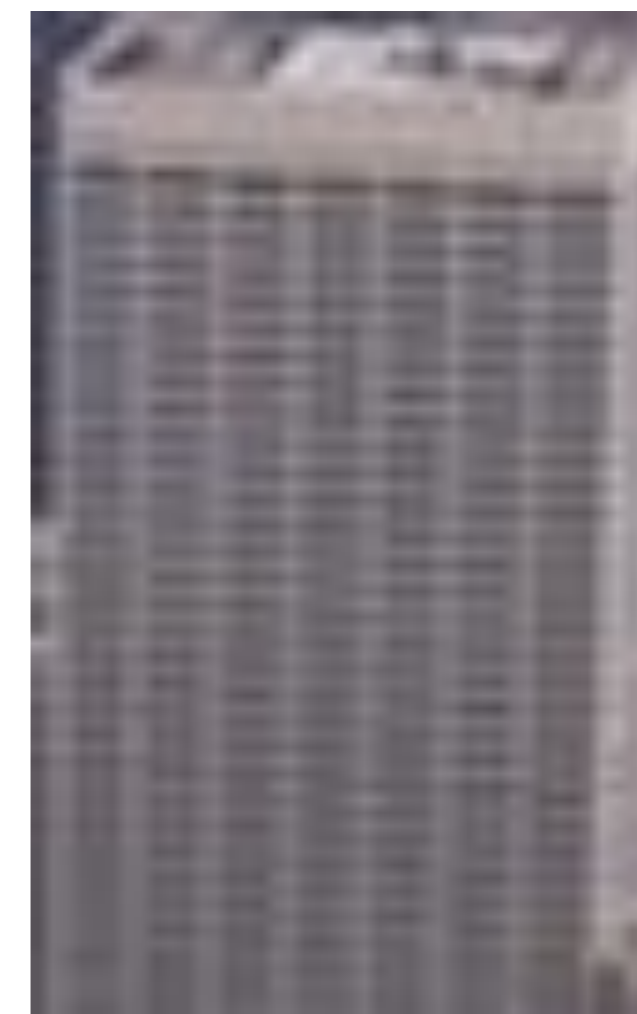


A repetition pattern region

SAD surface

- Ambiguous Wrong MV is selected for each block in RPRs



original frame     motion field     flow – color

**An example with a region contains 5 repetition pattern blocks**
MV $Set_1$ = {[-2,-4], [-2, 0]}
MV $Set_2$ = {[-6,-4], [-2, 0]}
MV $Set_3$ = {[-2,-4], [-2, 0], [2, 0], [8, 0]}
MV $Set_4$ = {[-6,-4], [-2, 0], [-2, 2], [4, 2]}
MV $Set_5$ = {[-2,-2], [-2, 0], [8, 0]}
Then, the histogram of MV candidates are as follows:
MV histogram = {[-6,-4], [-2,-4], [-2,-2], **[-2, 0]**, [-2, 2], [2, 0], [4, 2], [8, 0]}
Corresponding counts: {2, 2, 1, **5**, 1, 1, 1, 2}
**The MV for the region is [-2, 0]**



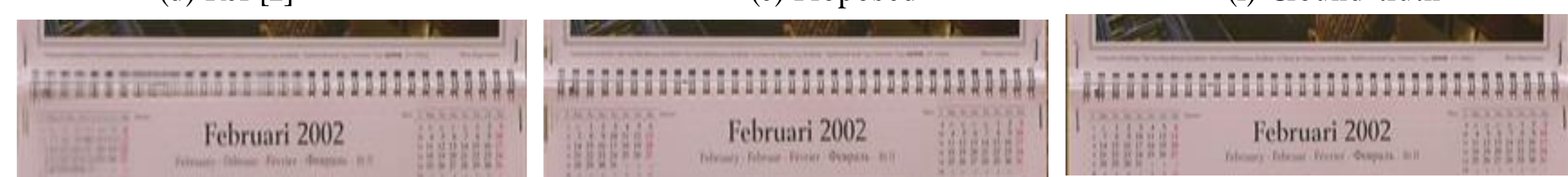(a) Ref [2]     (b) Proposed     (c) Ground truth

(d) Ref [2]     (e) Proposed     (f) Ground truth

(g) Ref [2]     (h) Proposed     (i) Ground truth

Visual Comparison

## 6. References

[1] S.H. Lee et.al. "Motion Vector Correction based on the Pattern-like Image Analysis," IEEE Trans. Cons. Elect., vol. 49, no. 3, Aug. 2003
[2] Y.W. Sohn and M.J. Kang, "Block based Motion Vector Smoothing for Periodic Pattern Region," in Proc. ICIAR, 2007