## 1. Introduction

Motion Compensated – Frame Rate up Conversion

- 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

## 2. Motivation

Motion Estimation for Repetition Pattern Regions

- Multiple local minima for Block Matching Algorithm in RPRs
- Ambiguous Wrong MV is selected for each block in RPRs

An example with a region contains 5 repetition pattern blocks

\[ \text{MV Set}_1 = \{-2, -4\}, \{-2, 0\} \]
\[ \text{MV Set}_2 = \{-6, -4\}, \{-2, 0\} \]
\[ \text{MV Set}_3 = \{-2, -4\}, \{-2, 0\}, \{2, 0\}, \{8, 0\} \]
\[ \text{MV Set}_4 = \{-6, -4\}, \{-2, 0\}, \{-2, 2\}, \{4, 2\} \]
\[ \text{MV Set}_5 = \{-2, -2\}, \{-2, 0\}, \{8, 0\} \]

Then, the histogram of MV candidates are as follows:

- \( \text{MV histogram} = \{-6, -4\}, \{-2, -4\}, \{-2, -2\}, \{-2, 0\}, \{-2, 2\}, \{2, 0\}, \{4, 2\}, \{8, 0\} \)

Corresponding counts: \( \{2, 2, 1, 5, 1, 1, 2\} \)

The MV for the region is \{-2, 0\}

## 3. Proposed Algorithm

### Step 1: Make MV Histogram of MV candidates

1. **Initialization:** All bins are the MV histogram are empty
2. **Build an MV set for each block**

**Core Algorithm**

For (each block \( k \))

- **Initialization:** \( \text{MV Set}_k = \{\text{Empty}\} \)
- 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 \( \text{size of (MV Set}_k) < 10 \)
      - push the local minimum into the MV Set\(_k\)
    - else {
      - find \( \text{MAX VALUE} = \max(\text{local minima in MV Set}_k) \)
      - if (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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSNR (dB)</td>
<td>( \Delta ) (dB)</td>
</tr>
<tr>
<td>Bus</td>
<td>24.72</td>
<td>2.23</td>
</tr>
<tr>
<td>Mobile</td>
<td>26.16</td>
<td>0.67</td>
</tr>
<tr>
<td>Calendar</td>
<td>28.80</td>
<td>4.86</td>
</tr>
<tr>
<td>Average</td>
<td>26.56</td>
<td>2.59</td>
</tr>
</tbody>
</table>

## 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.

## 6. References