**Research Contents**

- **DIRECT mode in B frame**
  - No need to transmit information of reference frame, block size, and motion vector.
  - Classification:
    - Temporal prediction;
    - Spatial prediction.
    - SKIP_16x16;
    - DIRECT_16x16;
    - DIRECT_8x8.
  - Aim: Reducing computation complexity; Keeping similar performance quality.
  - Proposal: Fast mode decision method based on temporal information.

- **Problems existing in the current algorithm**
  - Motion estimation (ME) is the most time-consuming part in the whole encoding process, in B slice, computation load becomes much heavier because of multiple direction prediction.

- **Proposed fast mode decision method**
  - DIRECT condition:
    \[
    \text{Mode:} (\text{Mode}_\text{PCO MB} \leq 1 && \text{Mode}_\text{NCO MB} \leq 1) \parallel (\text{Mode}_\text{NCO MB} = 0)
    \]
    \[
    \text{RD cost:} J_{\text{CURRENT MB}} < \alpha \times J_{\text{PCO MB}} \parallel J_{\text{CURRENT MB}} < \beta \times J_{\text{NCO MB}}
    \]
  - Start
  - Get Direct Motion Vector
  - Calculate the RD cost
  - Decide other modes
  - Update multipliers \(\alpha\) and \(\beta\)
  - END

- **Mode decision in H.264/AVC**
  - In High complexity mode, the encoder decides the best mode based on minimizing the RD cost:
    \[
    J(s, c, \text{MODE} | \text{QP}, \lambda_{\text{MODE}}) = \lambda_{\text{MODE}} \times R(s, c, \text{MODE} | \text{QP}) + SSD(s, c, \text{MODE} | \text{QP})
    \]

- **Potentiality of fast DIRECT mode decision**

- **Test results**
  - | sequence | method | TS (%) | BDPNSNR (dB) | BDBR (%) |
  - | | | | | |
  - | mobile | Jlee | 2.0 | 2.9 | 7.7 | 22.1 | -0.03 | 0.51 |
  - | qcif | our | 29.4 | 29.0 | 31.7 | 39.6 | -0.10 | 1.95 |
  - | hall | Jlee | 2.0 | 6.3 | 34.6 | 53.1 | 0.00 | 0.08 |
  - | qcif | our | 47.8 | 50.3 | 55.7 | 57.7 | -0.05 | 1.75 |
  - | container | Jlee | 8.8 | 44.1 | 56.0 | 63.6 | -0.03 | 0.89 |
  - | cif | our | 49.6 | 57.2 | 61.0 | 65.3 | -0.03 | 0.93 |
  - | coastguard | Jlee | 1.6 | 4.3 | 11.6 | 24.7 | -0.02 | 0.40 |
  - | cif | our | 37.5 | 35.0 | 36.0 | 39.2 | -0.08 | 1.44 |
  - | mbscale | Jlee | 0.0 | 4.4 | 13.9 | 39.2 | -0.02 | 0.85 |
  - | 720p | our | 54.4 | 52.8 | 49.8 | 54.7 | -0.07 | 2.45 |
  - (a) GOP: IBPBP
  - (b) GOP: BPBP