Fast H.264/AVC DIRECT Mode Decision based on Mode Selection and Predicted Rate-Distortion Cost

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Research Contents

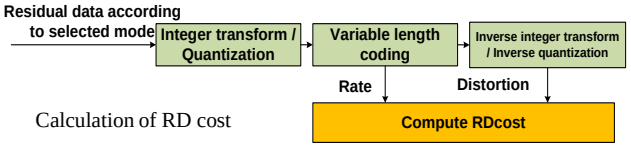
DIRECT mode in B frame

- 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.

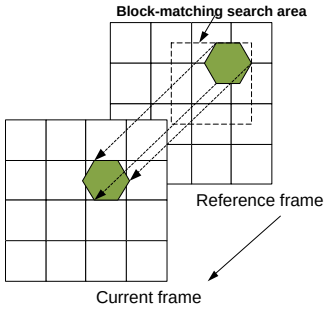
Mode decision in H.264/AVC

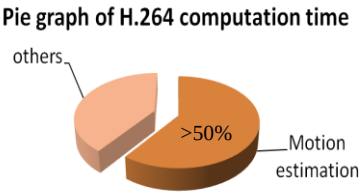
In High complexity mode, the encoder decides the best mode based on minimizing the RD cost:

$$J(s,c,MODE \mid QP,\lambda_{MODE}) = \lambda_{MODE} * R(s,c,MODE \mid QP) + SSD(s,c,MODE \mid QP)$$



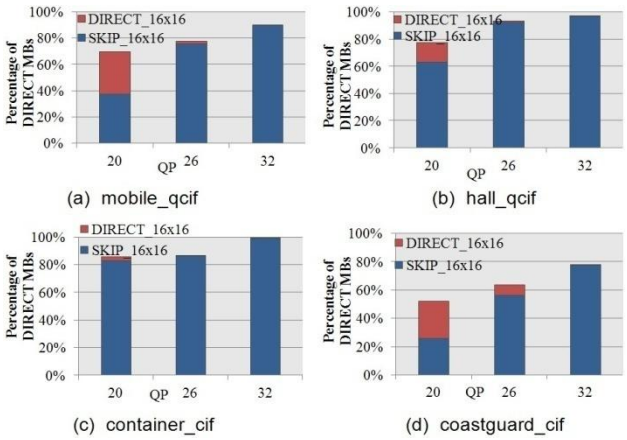
Problems existing in the current algorithm





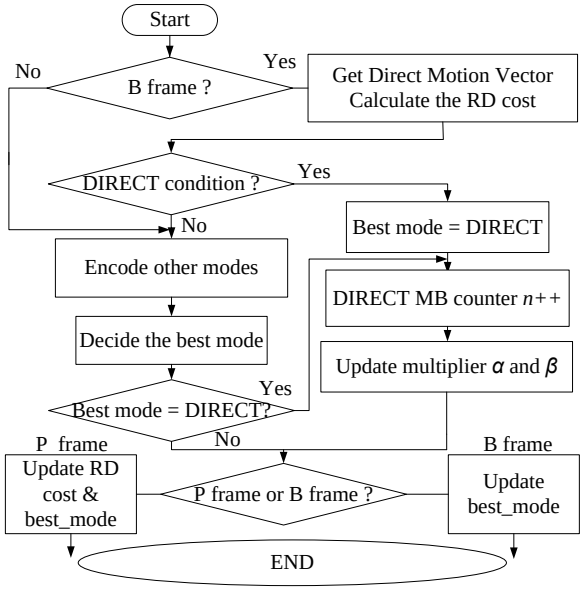
Motion estimation (ME) is the most time-consuming part in the whole encoding process, in B slice, computation load becomes much heavier because of multiple direction prediction.

Potentiality of fast DIRECT mode decision



Percentage of DIRECT MBs

Proposed fast mode decision method



DIRECT condition:

$$\begin{cases} Mode: (Mode_{PCO.MB} \le 1 \;\&\&\; Mode_{NCO.MB} \le 1) \,||\, (Mode_{BCO.MB} = 0) \\ RD\ cost: J_{CURRENT\_MB} < \alpha \times J_{PCO.MB} \;||\; J_{CURRENT\_MB} < \beta \times J_{NCO.MB} \end{cases}$$

Test results

sequence	method	TS (%) QP=16	QP=20	QP=24	QP=28	BDPSNR (dB)	BDBR (%)
mobile qcif	Jlee	2.0	6.6	14.4	28.1	-0.02	0.28
	our	31.9	32.1	34.2	39.6	-0.04	0.70
hall qcif	Jlee	2.0	5.3	28.4	43.5	0.00	-0.01
	our	39.4	42.3	45.5	47.9	-0.03	0.94
container cif	Jlee	8.1	39.7	48.1	53.9	0.03	-0.76
	our	49.3	52.3	53.8	55.5	0.03	-0.79
coastguard cif	Jlee	1.3	4.5	13.1	24.6	-0.02	0.30
	our	31.3	30.6	32.1	34.4	-0.05	0.86
mobcal 20p	Jlee	0.3	3.9	12.1	33.7	-0.01	0.42
	our	47.8	44.0	42.3	46.2	-0.03	0.87

(a) GOP: IBPBP

sequence	method	TS (%) QP=16	QP=20	QP=24	QP=28	BDPSNR (dB)	BDBR (%)
mobile qcif	Jlee	2.0	2.9	7.7	22.1	-0.03	0.51
	our	29.4	29.0	31.7	39.6	-0.10	1.95
hall qcif	Jlee	2.0	6.3	34.6	53.1	0.00	-0.08
	our	47.8	50.3	55.7	57.7	-0.05	1.75
container cif	Jlee	8.8	44.1	56.0	63.6	-0.03	0.89
	our	49.6	57.2	61.0	65.3	-0.03	0.93
coastguard cif	Jlee	1.6	4.3	11.6	24.7	-0.02	0.40
	our	37.5	35.0	36.0	39.2	-0.08	1.44
mobcal 720p	Jlee	0.0	4.4	13.9	39.2	-0.02	0.85
	our	54.4	52.8	49.8	54.7	-0.07	2.45

(b) GOP: IBBPBBP

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