

MOTION ADAPTIVE INTERPOLATION WITH MORPHOLOGICAL OPERATION AND 3:2 PULL-DOWNED RECOVERY FOR DEINTERLACING

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Introduction

- ◆ Translate the interlace format of video to progressive device as plasma, projection TV, projector, and computer



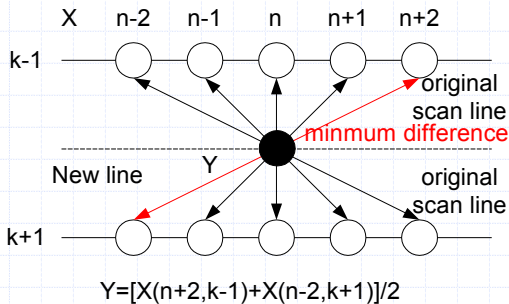
Plasma Display



Previous Work- Intra-Field Interpolation

◆ ELA (Edge Line Average)

- Preserve the edge direction



(a) Bilinear



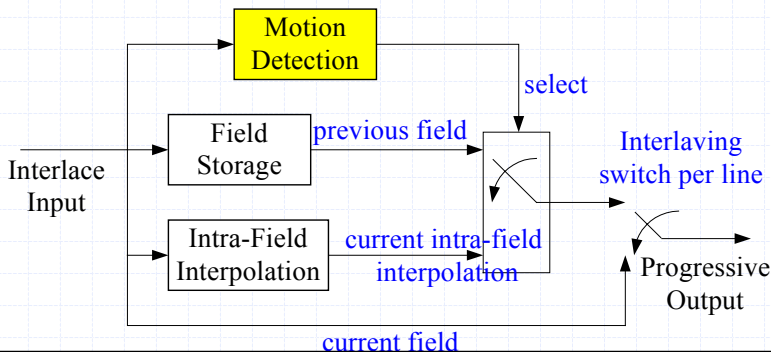
(b) ELA

- ◆ Some defects may be appeared while an object only exists in the same parity field

Previous Work- Motion Adaptive Deinterlacing

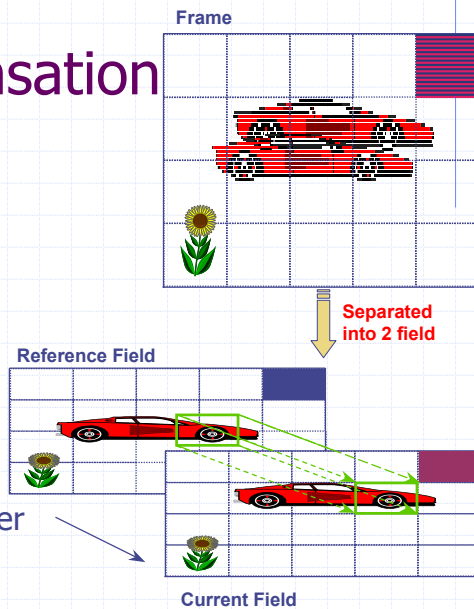
- ◆ Intra-field interpolation in motion area and inter-field interpolation in static area

- Needs a reliable motion detection



Previous Work- Motion Compensation

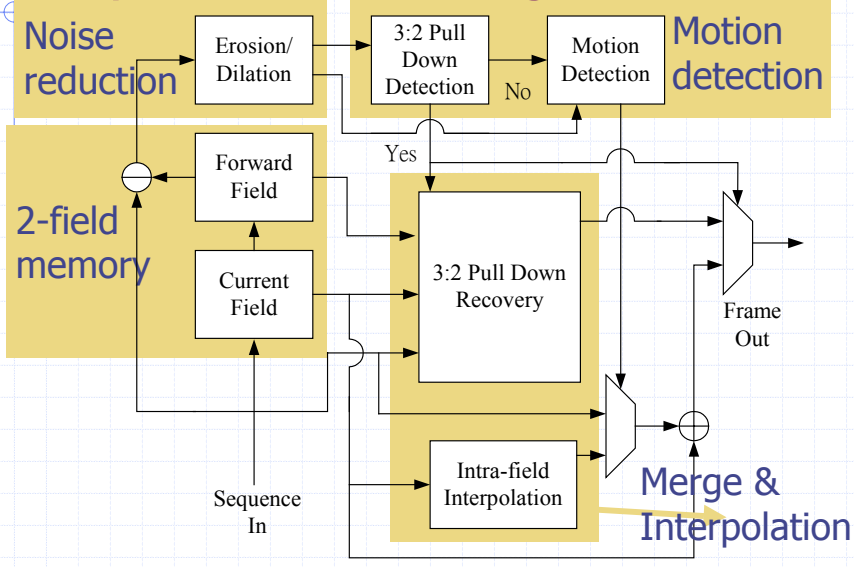
- ◆ Find the matching block in the neighbor field
- ◆ Advantage
 - Can get higher quality
- ◆ Drawback
 - Large computational power
 - Hardware cost is too high



Motivation

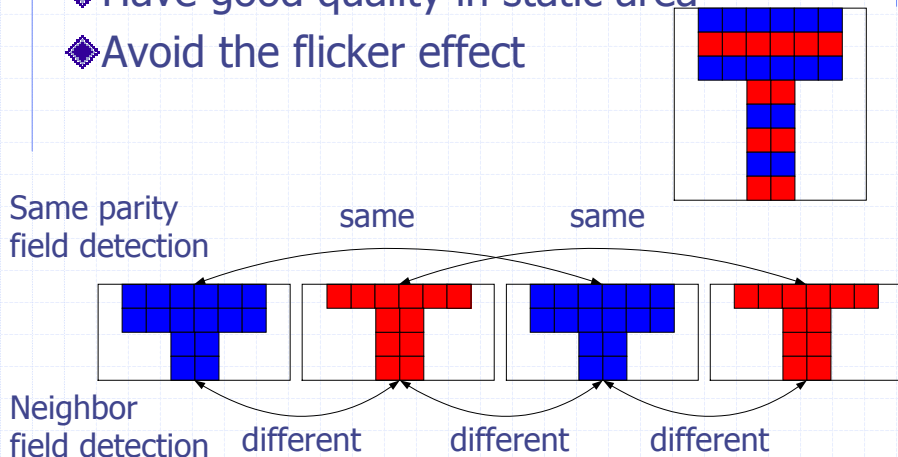
- ◆ Previous Work
 - Intra-field interpolation
 - ◆ Low resolution
 - Motion adaptive deinterlacing
 - ◆ Needs a reliable motion detection
 - Motion compensated deinterlacing
 - ◆ Large computational power and hardware cost
- ◆ Proposed
 - Fast & Cost –efficient method
 - Reliable motion detection

Proposed Block Diagram



Same Parity Field Motion Detection

- ◆ Have good quality in static area
- ◆ Avoid the flicker effect



Morphological Operation

◆ Erosion

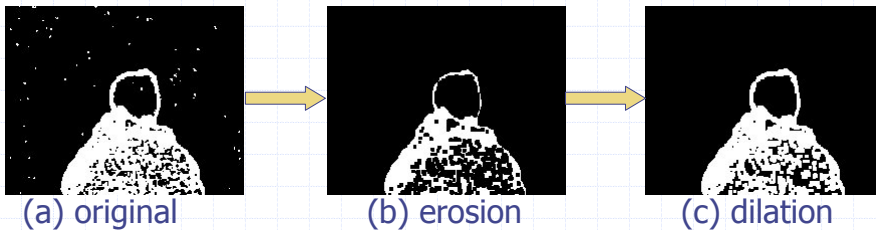
- Noise reduction

$$G(j,k)=\text{MIN}[F(j,k), F(j,k+1), F(j-1,k+1), \dots, F(j+1,k+1)]$$

◆ Dilation

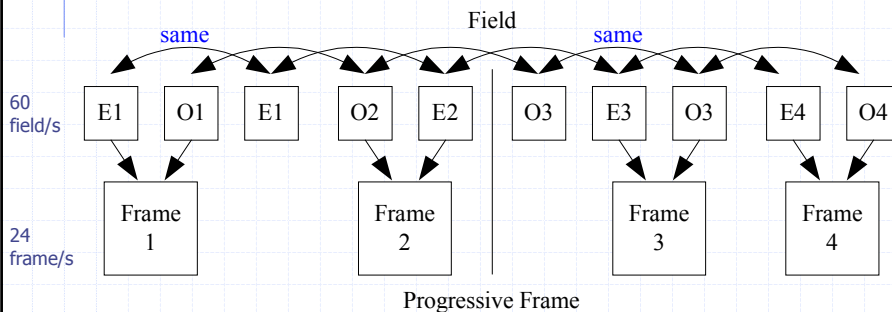
- Expand the motion area

$$D(j,k)=\text{MAX}[G(j,k), G(j,k+1), G(j-1,k+1), \dots, G(j+1,k+1)]$$



3:2 Pull Down Recovery

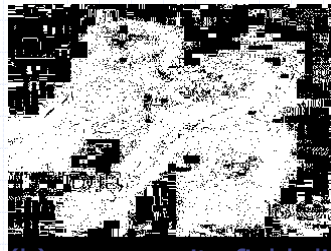
- ◆ Same parity detection as motion detection can saving hardware cost



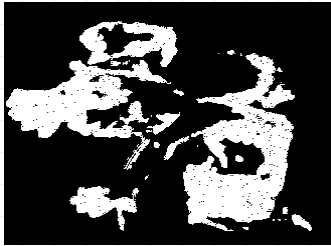
Simulation Results



(a) original field



(b) same parity field difference



(c) erosion



(d) after erosion and dilation

Simulation Results in Static Area



(a) original frame



(b) Line doubling

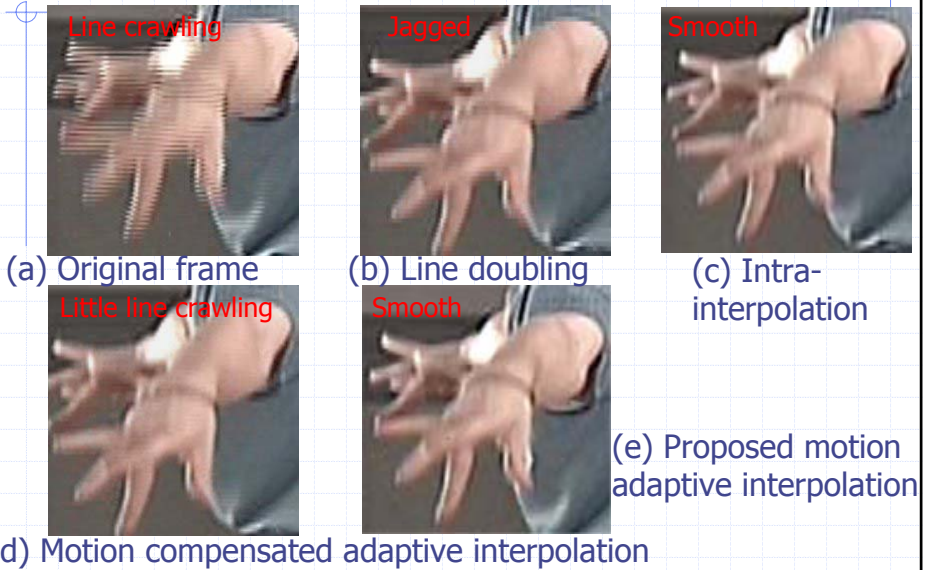


(c) Intra-interpolation

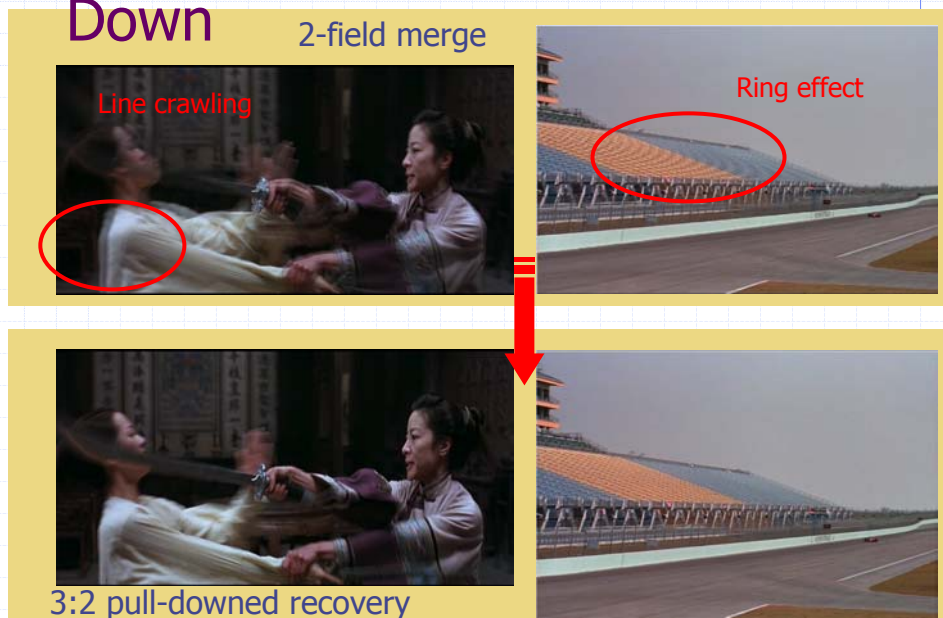


(d) proposed motion adaptive interpolation

Simulation Results in Motion Area



Simulation Results for 3:2 Pull Down



Comparison of Hardware Cost

	Complexity	Memory Access Count [pixel]		Memory Usage [byte]	Computational Time [sec/frame]
		Read	Write		
Bilinear	$O(n)$	1	1	1	0.2
ELA	$O(n)$	2	1	10	0.3
M.C.	$O(n^2 \times SR^2)$	226	1	640	10
Proposed	$O(n)$	6	1	9	0.4

n: number of pixels

Athlon K7-700Mhz, 384 Mbytes, Win2000

MC: search range +7~-7, block size 8x8

Conclusions

- ◆ Same parity field check can be adopted in 3:2 pull-down and motion detection circuit for saving hardware-cost.
- ◆ Morphological operation can suppress the visual artifacts and get higher image quality .
- ◆ A fast & efficiently-cost method which is suitable for VLSI design is proposed.