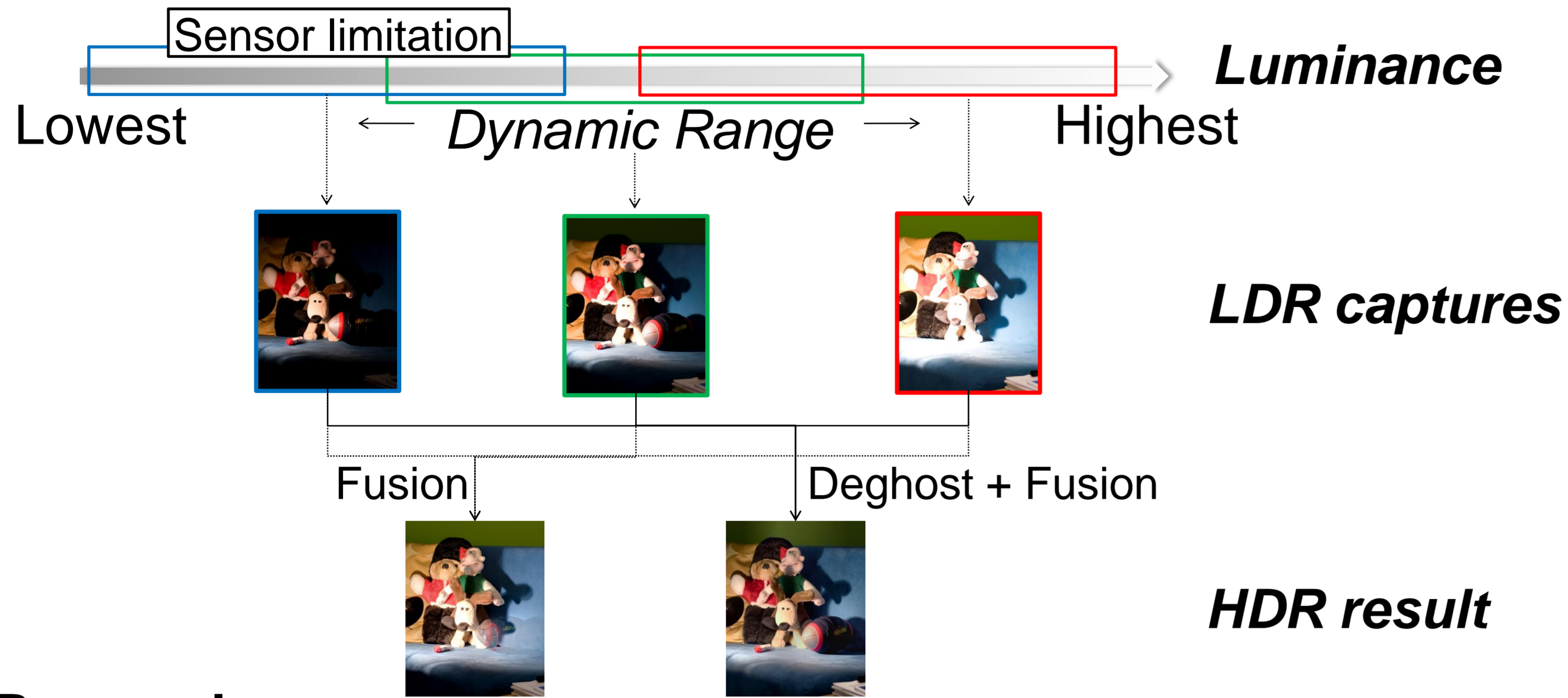# Visual Salience and Stack Extension Based Ghost Removal for High-dynamic-range Imaging

Zijie Wang, Qin Liu, Takeshi Ikenaga
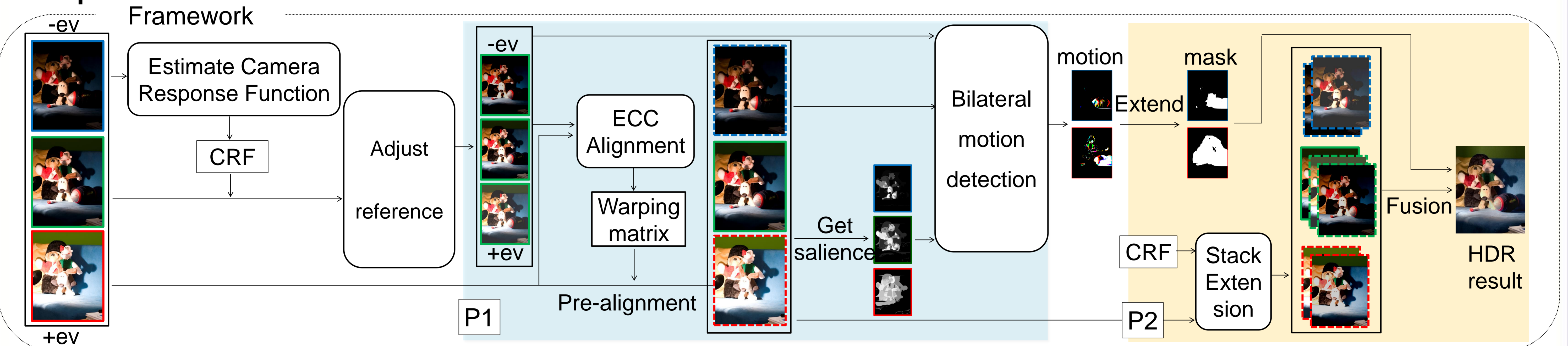
➢ Background

Sensor limitation

Luminance

Lowest ← *Dynamic Range* → Highest

LDR captures

Fusion   Deghost + Fusion
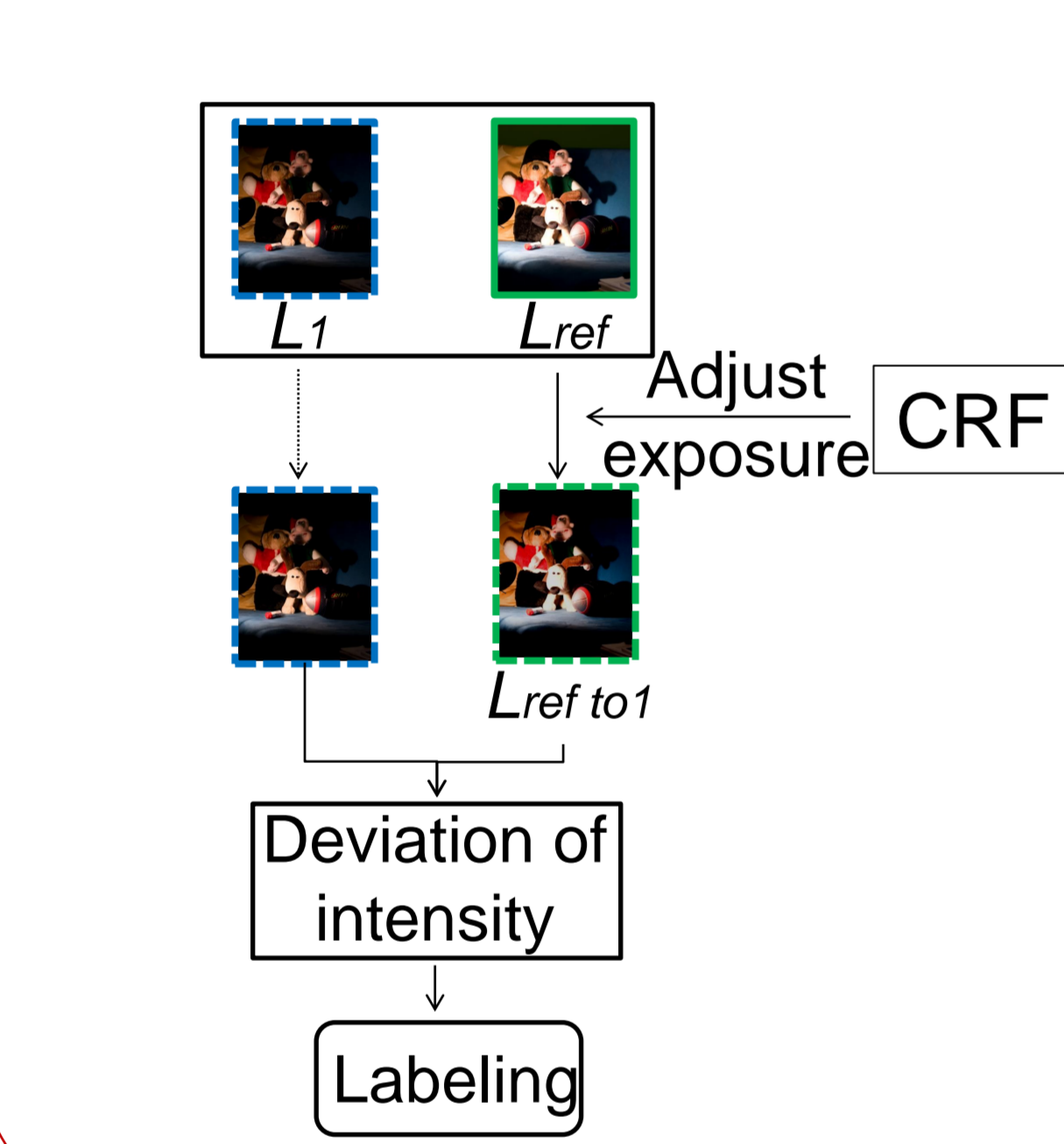
HDR result

Problems in ghost removal

➢ High complexity of non-rid registration
→ **Motion detection based method**
➢ Remained artifacts due to inaccurate motion detection
→ **Proposal 1: Visual salience based bilateral motion detection**
➢ Brightness discontinuity due to deficient fusion source
→ **Proposal 2: Stack extension based exposure fusion**
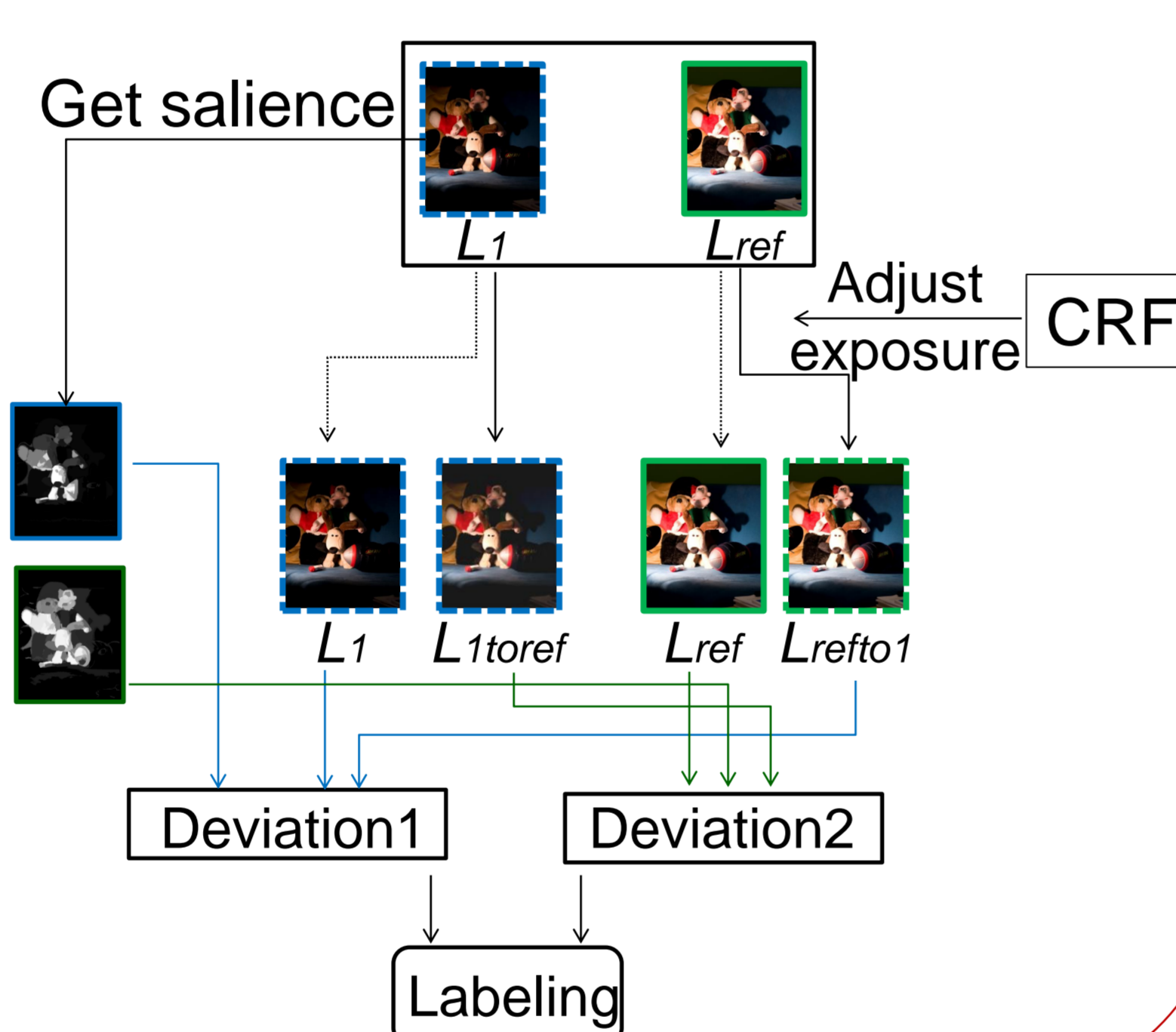
➢ Proposals

Framework

-ev

Estimate Camera Response Function → CRF → Adjust reference

-ev / +ev → ECC Alignment → Warping matrix → Pre-alignment

P1

Get salience → Bilateral motion detection → motion → Extend → mask

CRF → Stack Extension

P2

Fusion → HDR result

+ev

P1: Visual salience based bilateral motion detection

Conventional   **Proposed**

L_1 L_{ref}

Adjust exposure → CRF

$L_{ref to 1}$

Deviation of intensity → Labeling

Get salience

L_1 L_{ref}

Adjust exposure → CRF

L_1 L_{1toref} L_{ref} L_{refto1}

Deviation1   Deviation2

Labeling

P2: Stack extension based exposure fusion

Conventional   **Proposed**

mask → Weight Map → Fusion
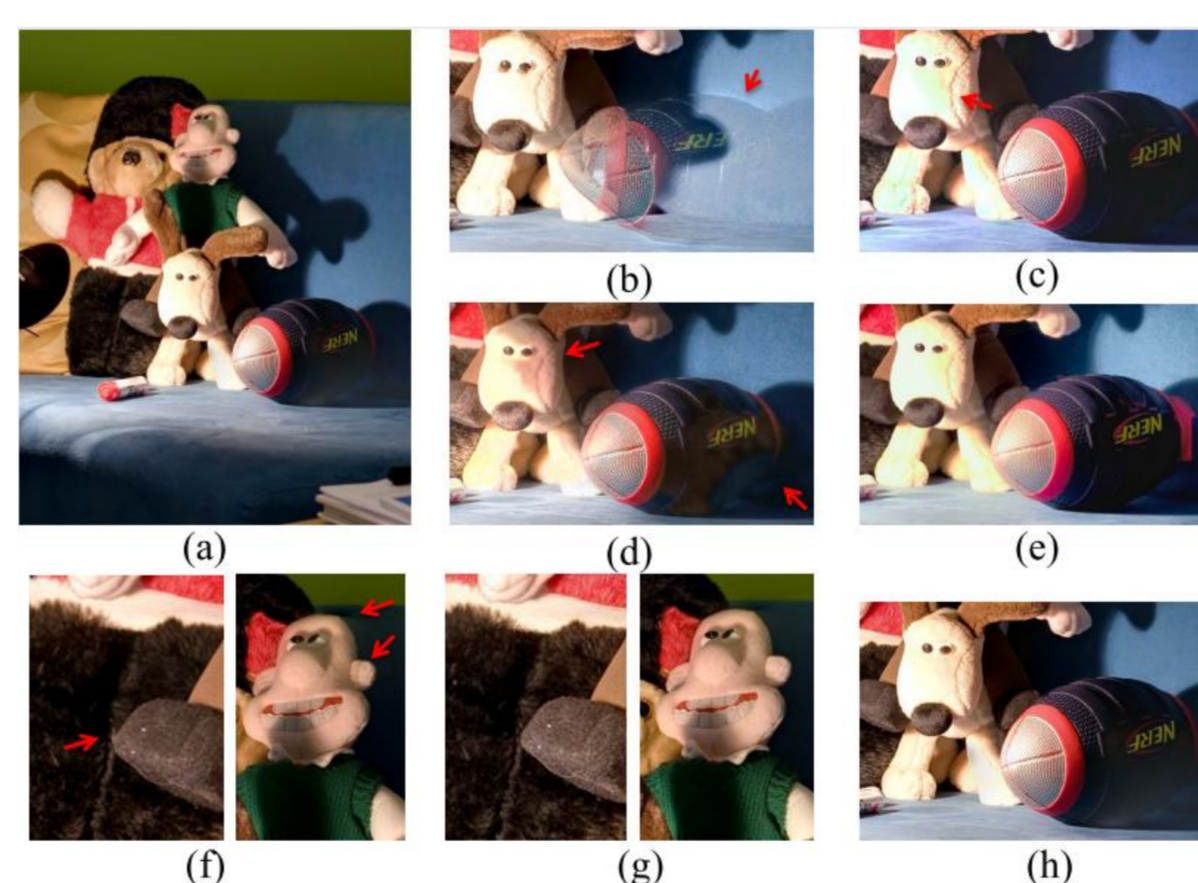
CRF

mask

+ev -ev +ev -ev

Weight Map → Fusion
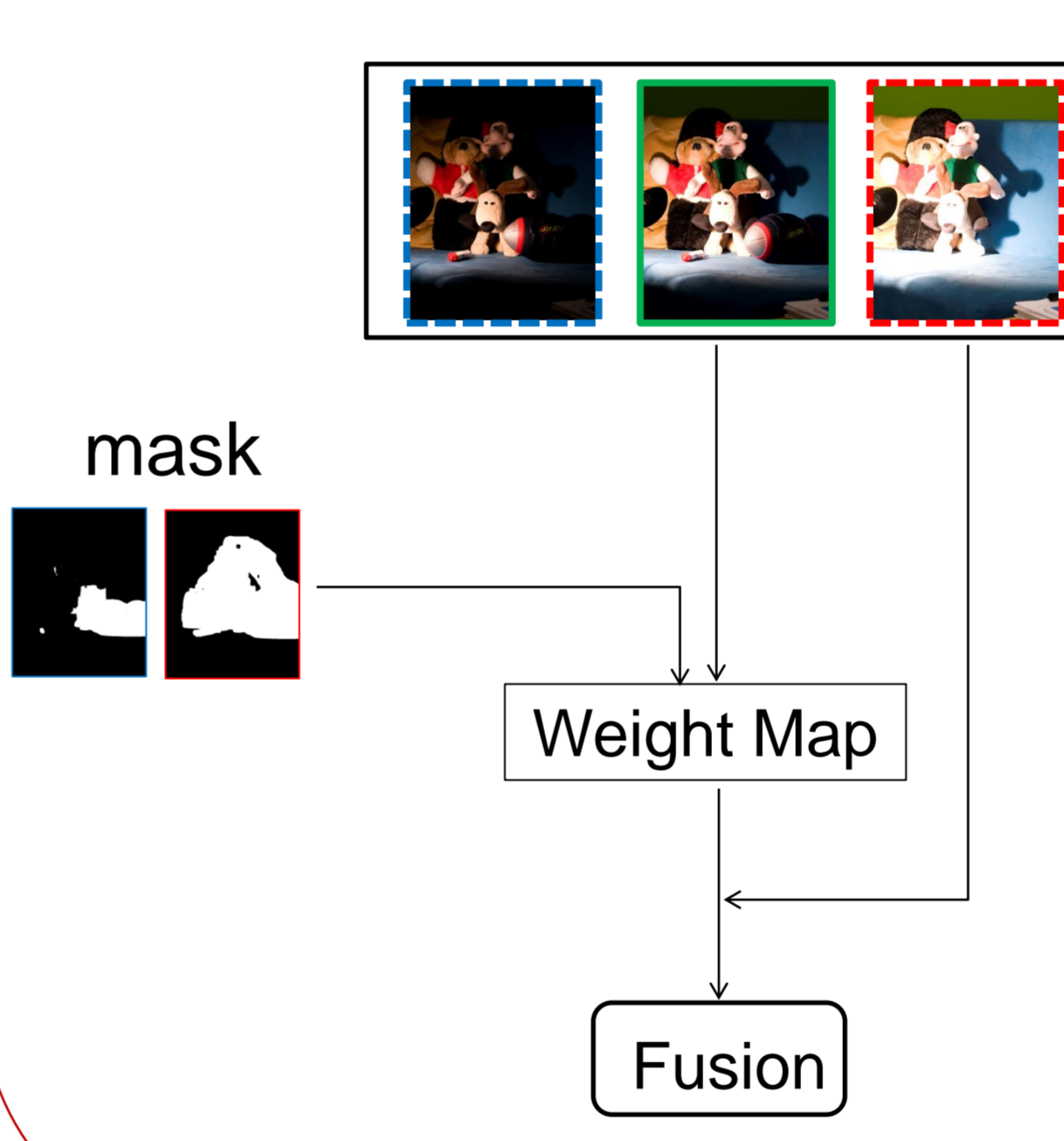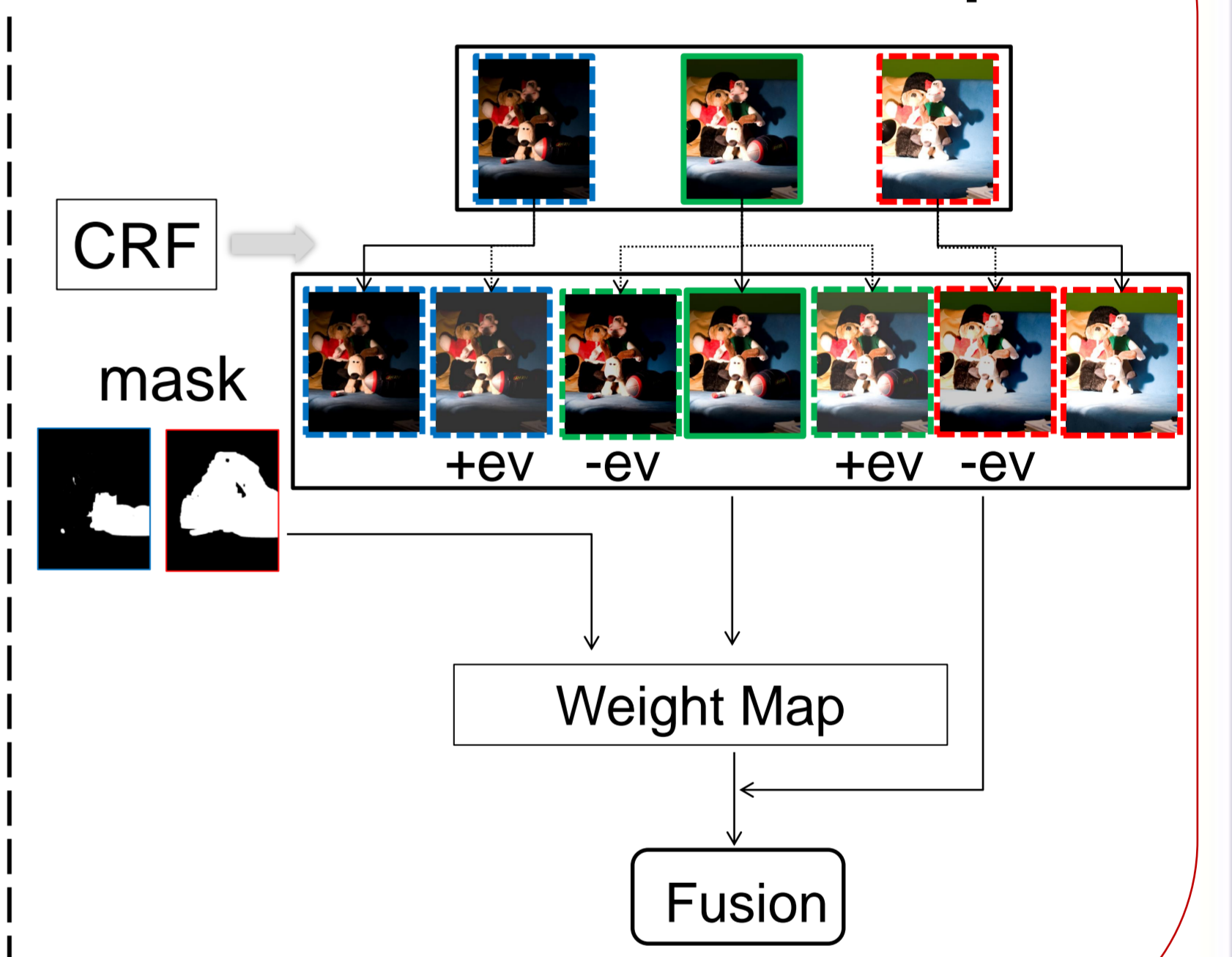
➢ Experiment result

Result of proposal 1

(a) reference (4th) image
(b) the 5th image (c) detected motion areas by [Zhang15] (d) proposed

Result of proposal 2

(a)(c) fusion result by [Mertens09]
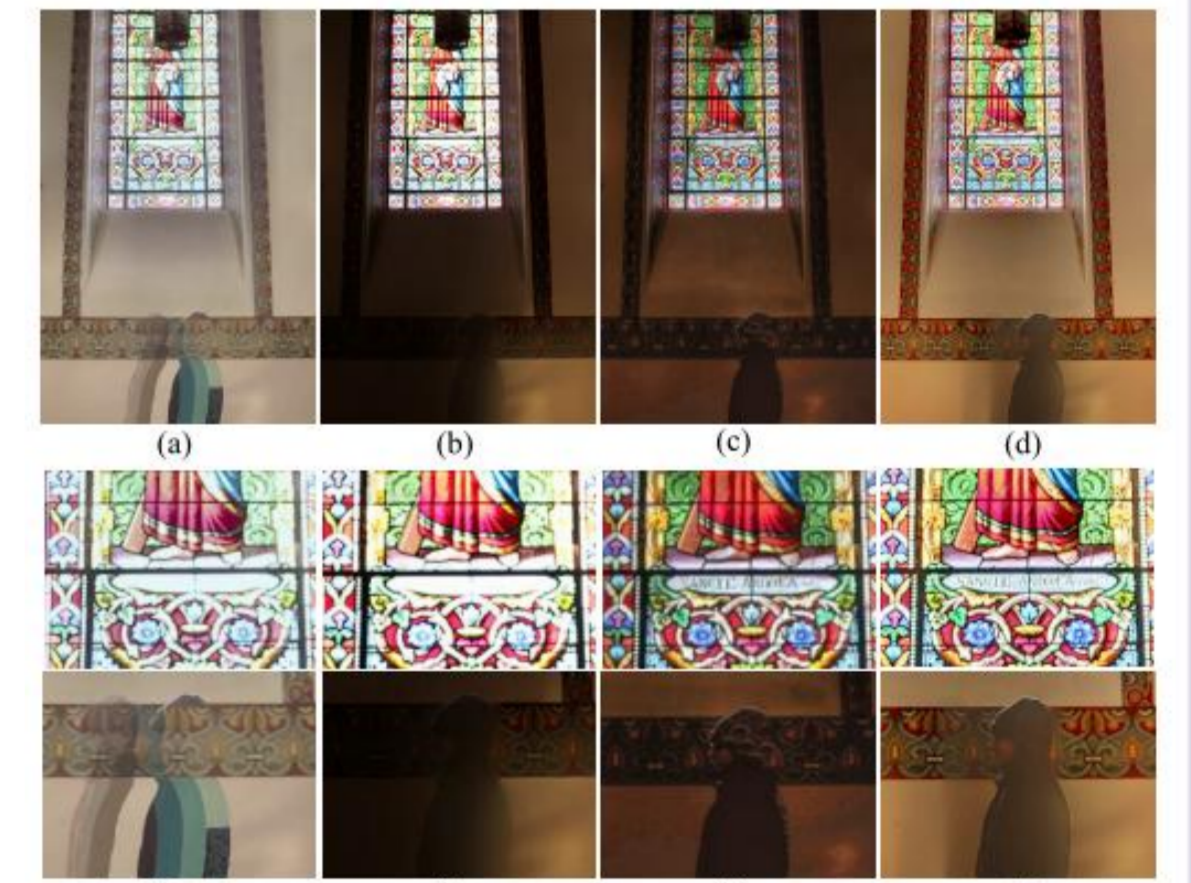(b)(d) proposed
Image courtesy of [Sen12]

Static dataset [Puppets]

(a)(g)(h) Proposed
(b) [Mertens09]
(c) [Gallo09]
(d) [Sen12]
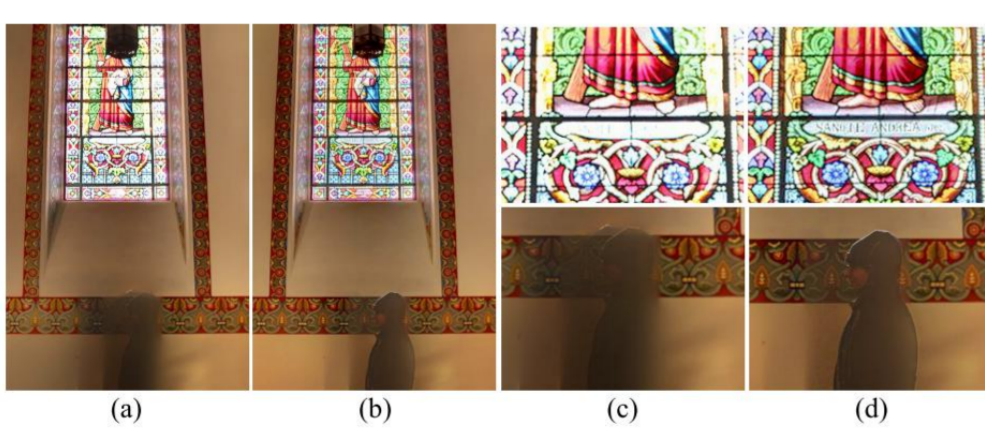(e) [Lee14]
(f) [Zhang15]
Image courtesy of [Gallo09]

Handheld dataset [StainedGlass]

(a)(e) [Lee14]
(b)(f) [Zhang15]
(c)(g) [Sen12]
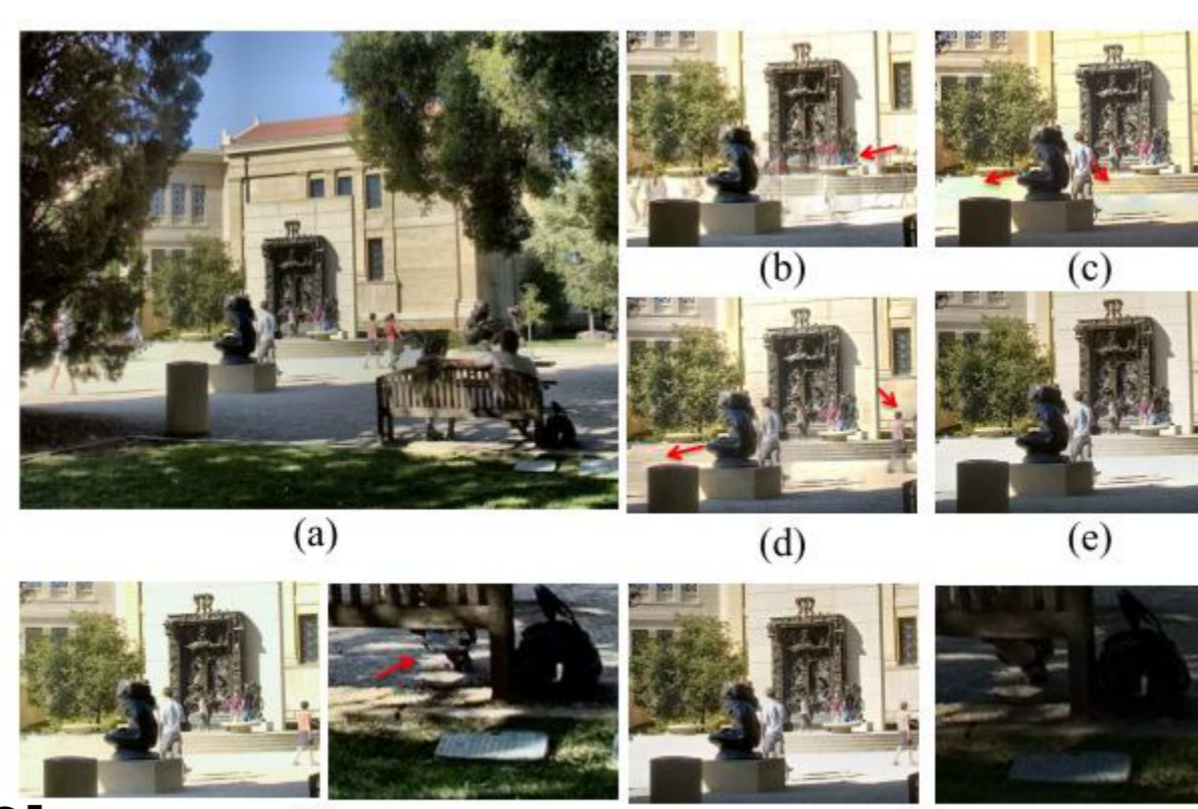(d)(h) Proposed
Image courtesy of [Sen12]

Performance comparison

Dataset \ Method	Lee	Sen	Proposed
Static camera			
Arch	374.3	165.4	**91.59**
Puppets	540.1	172.5	**113.71**
SculptureGarden	253.9	233.0	**105.1**
Forest	223	145.9	**79.74**
Average	347.8	184.4	**97.5**
Handheld			
StainedGlass1	284.7	297.1	**236.6**
StainedGlass2	379.5	197.8	**136.3**
Pianoman	1033.1	**210.3**	338.7
GoingOutTheDoor	791.7	334.9	**312.6**
Average	622	260	**256.1**

Static dataset [SculptureGarden]

(a)(g) Proposed
(b) [Mertens09]
(c) [Gallo09]
(d) [Sen12]
(e) [Zhang15]
(f) [Lee14]
Image courtesy of [Gallo09]

Handheld dataset [GoingOutTheDoor]

(a) [Lee14]
(b) [Zhang15]
(c) [Sen12]
(d) Proposed
Image courtesy of [Sen12]

➢ Conclusion

Visual salience based bilateral motion detection → More robust and accurate

Stack extension based exposure fusion → Reduce brightness discontinuity artifacts

The proposed method provides significant gains in deghosting quality and robustness with low complexity.