

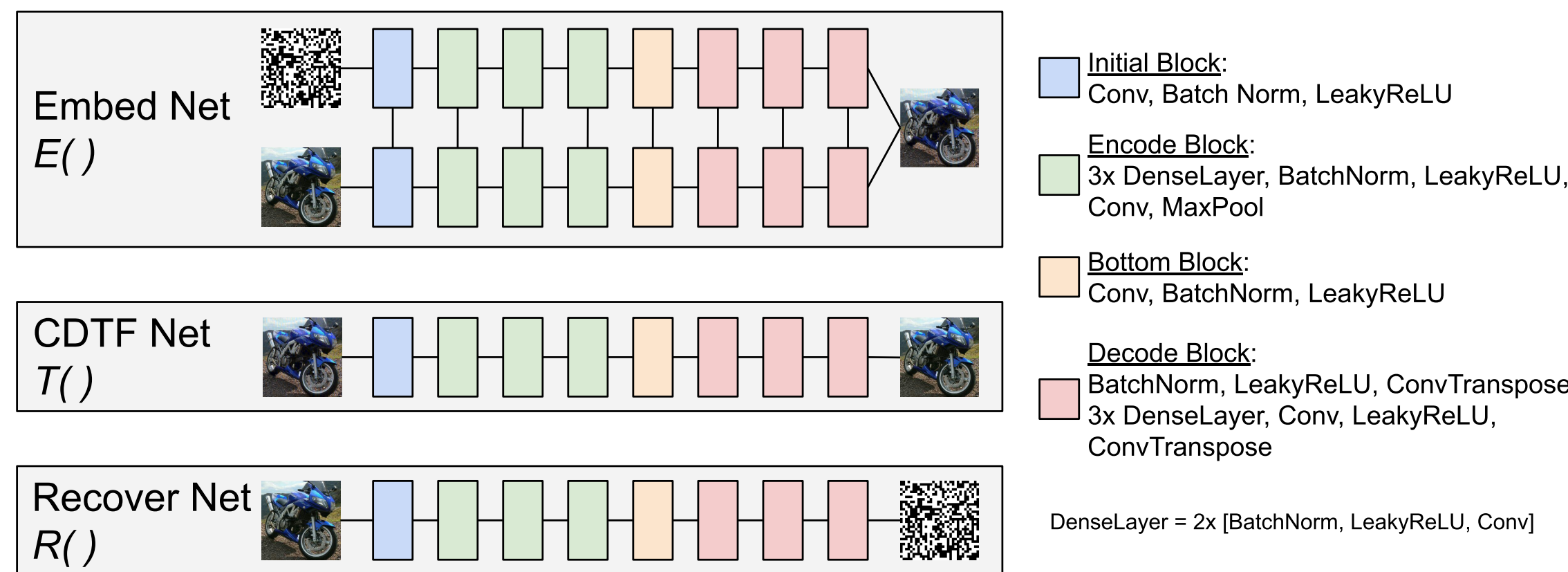
 i_c  i_m  i'_c  i''_c  i'_m

Light field messaging (LFM) transmits imperceptible, camera-readable messages with minimal bit error rate (BER).

Objective Function

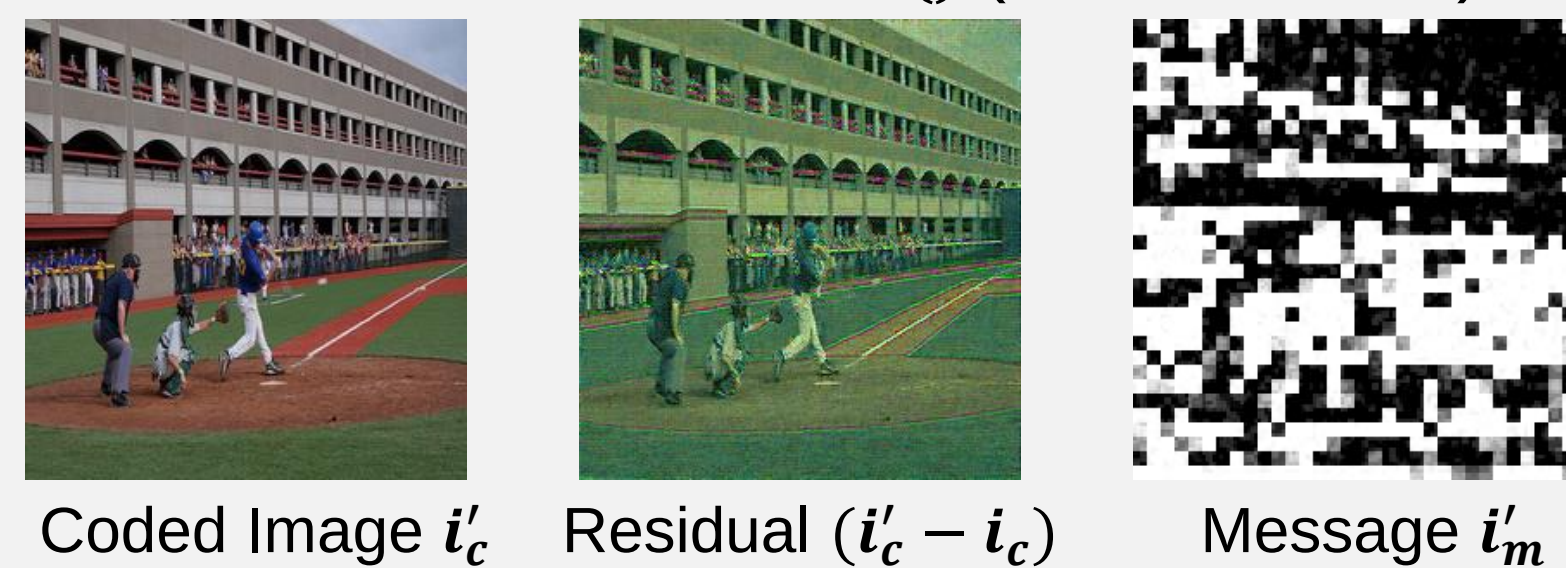
minimize: $L_2|i'_c - i_c| + L_1|i'_m - i_m|$
subject to: $E(i_c, i_m) = i'_c$ coded image
 $T(i'_c) = i''_c$ after transmission
 $R(i''_c) = i'_m$ recovered message

CNN Architecture



Modeling Camera-Display Transfer Function (CDTF) in Training

LFM Trained **Without $T()$** (46.39% BER)



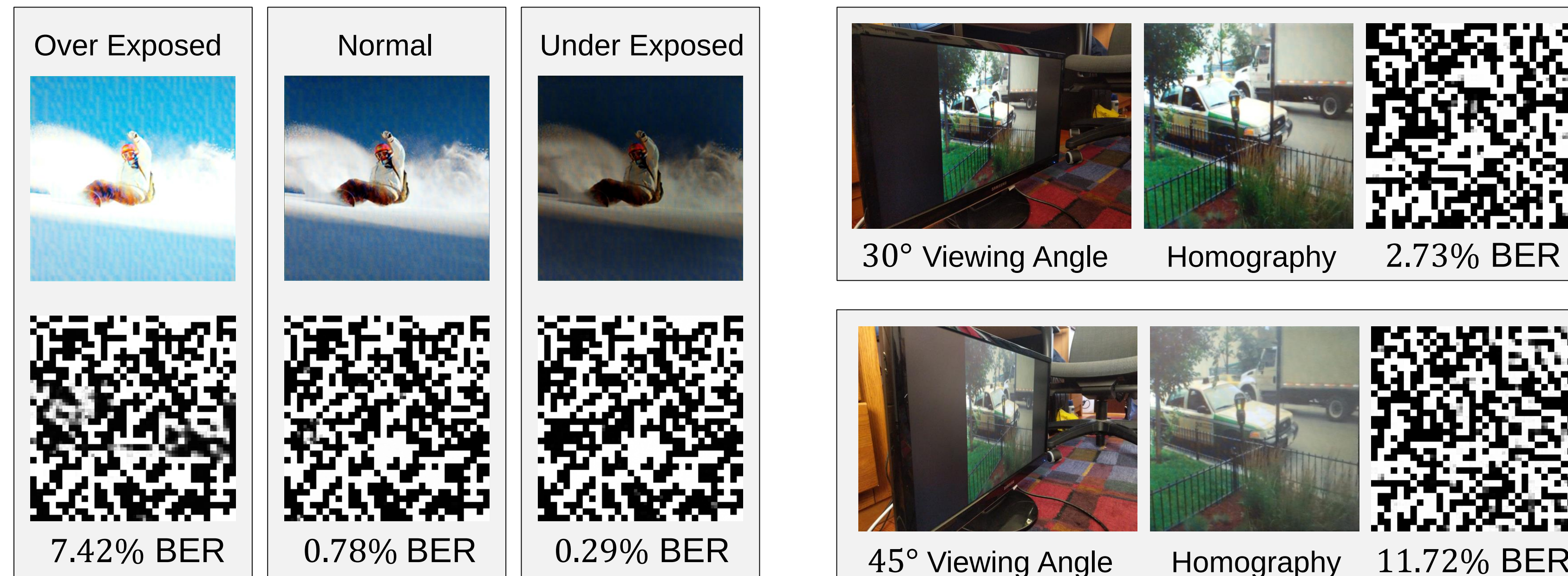
LFM Trained **With $T()$** (1.17% BER)



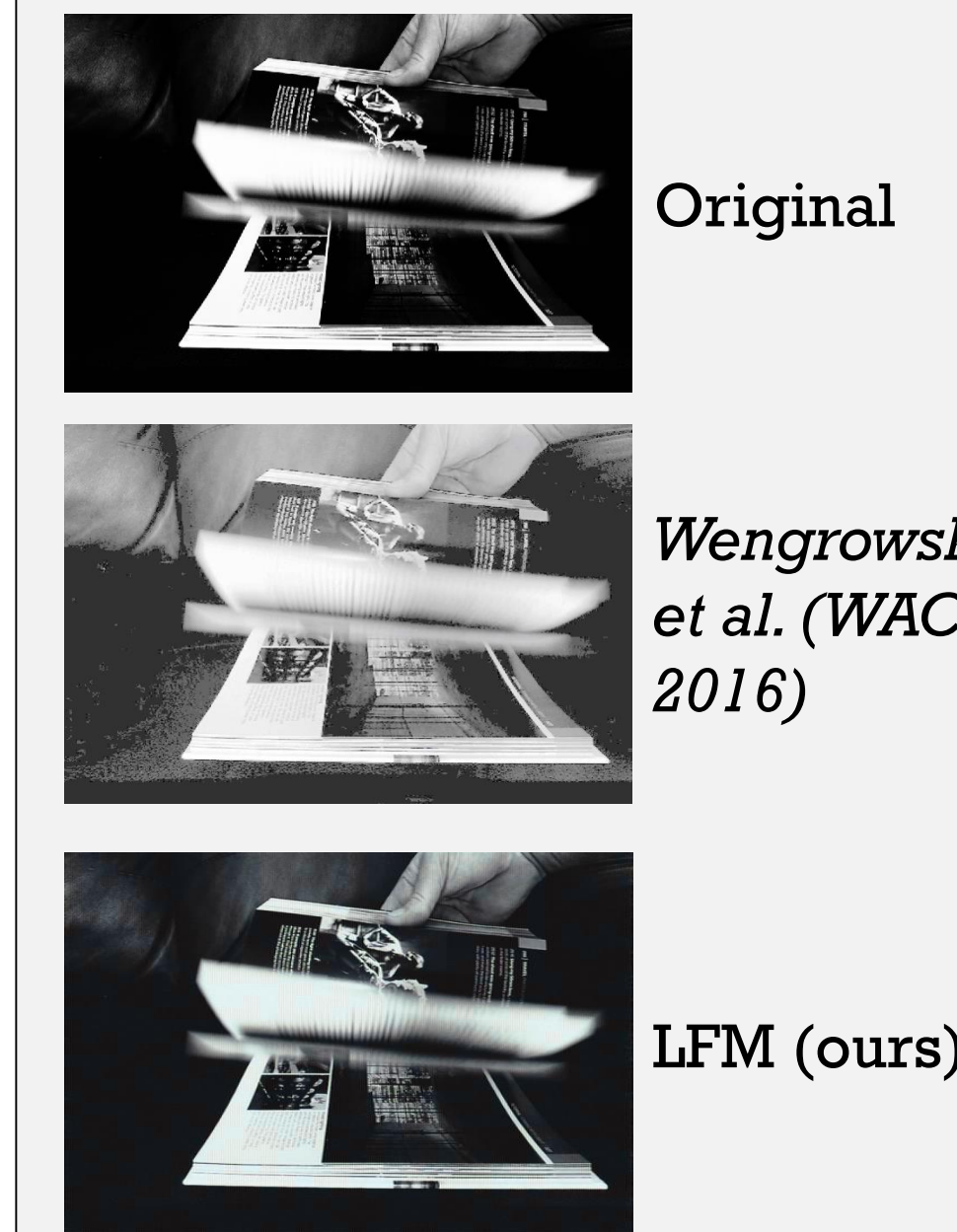
Camera-Display 1M Dataset: 1,000,000+ Images from 25 Camera-Display Pairs



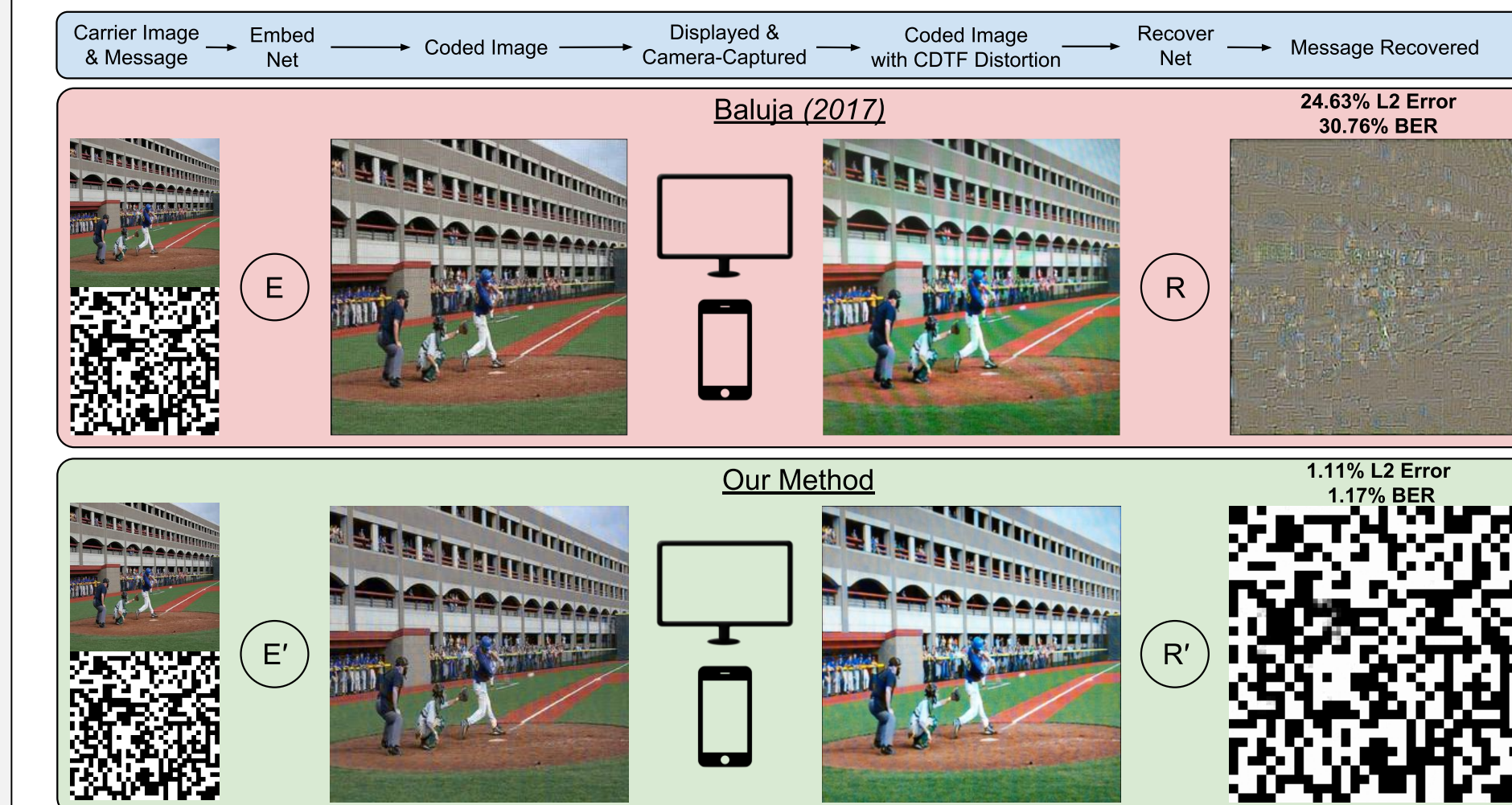
Results: Robust to Exposure Settings and Viewing Angle



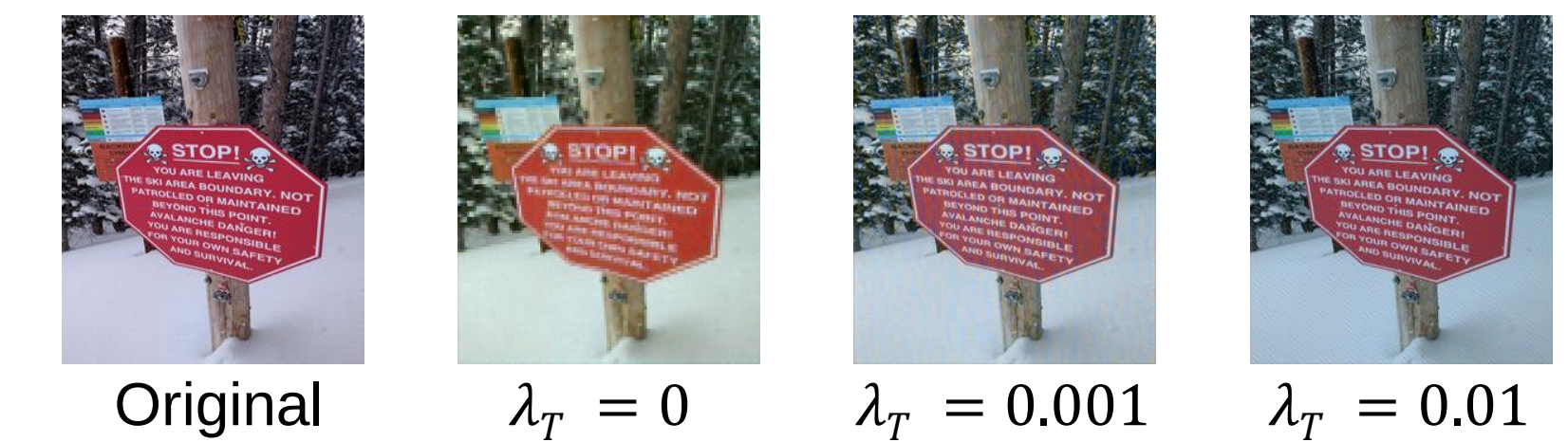
Compare to Wengrowski et al. (WACV 2016)



Compare to Baluja (NIPS 2017)



Perceptual Loss Ablation Study



Results: BER (Lower is Better)	Pixel 2 & Samsung 2494SJ	Basler acA2040-90uc & Acer S240ML	Logitech c920 & Insignia NS-40D40SNA14	iPhone 8 & Acer Predator XB271HU	Basler acA1300-30uc & Dell 1707FPt
LFM without $T()$, frontal	49.96%	50.14%	50.05%	50.11%	50.04%
LFM with $T()$, 45°(ours)	29.81%	15.23%	10.22%	5.14%	10.01%
LFM with $T()$, frontal (ours)	10.05%	6.58%	10.33%	5.07%	4.83%

Results: BER on New Hardware (Lower is Better)	Sony Cybershot DSC-RX100 & Lenovo Thinkpad X1 Carbon 3444-CUU	Sony Cybershot DSC-RX100 & Apple Macbook Pro 13-inch, Early 2011	Nikon Coolpix S6000 & Lenovo Thinkpad X1 Carbon 3444-CUU	Nikon Coolpix S6000 & Apple Macbook Pro, 13-inch Early 2011
DCT (Kamya, 2014), frontal	50.01%	50.13%	50.00%	49.95%
Baluja (NeurIPS 2017), frontal	40.37%	37.15%	48.50%	48.83%
LFM without $T()$, frontal	50.06%	49.95%	50.00%	50.00%
LFM with $T()$, 45°(ours)	12.97%	15.59%	27.43%	25.81%
LFM with $T()$, frontal (ours)	9.17%	7.31%	20.45%	17.56%