Goal
Segment dynamic objects given a single space-variantly blurred image of a 3D scene captured using a hand-held camera.

Challenges
Single image
Camera/ object motion ⇒ motion blur
3D scene ⇒ defocus blur
General camera motion/ 3D scene ⇒ space-varying blur
Depth-motion ambiguity

Our approach
Train a CNN to predict the composite kernel \( h_{c} \) at each pixel.
Composite kernel is convolution of defocus \( h_{d} \) and motion \( h_{m} \) kernels.
Use defocus cue to recover the depth map.
Use motion kernels to segregate the dynamic objects at each depth layer.
Joint model for defocus and motion helps resolve depth-motion ambiguity.

Scene segmentation
Layer with maximum area in depth map = Reference depth layer \( d_{0} \)
Segmenting moving objects in the reference depth layer \( d_{0} \)
Blur on dynamic object pixel ≠ Blur on pixel affected only by camera motion

Blur compatibility test [2]
- Select two pixels with motion kernels \( h_{m1} \) and \( h_{m2} \).
- Find \( n_{1} = (\Delta h_{m1}(i, j) - \Delta h_{m2}(i, j)) > 0 \), where \( i, j ∈ 1, 2 \).
- Calculate \( n_{2} = n_{1} \cap n_{3} \).
- Regenerate \( h_{m1} \) and \( h_{m2} \) using \( n_{2} \).
- The two pixels are NOT "blur compatible" if \( h_{m1} \) and \( h_{m2} \) have positive entries at locations other than those in \( n_{1} \) and \( n_{2} \).

Segmenting moving objects at other depths \( d_{c} \)
Depth map and motion experienced by reference layer are known ⇒
Kernel at a pixel lying on any other depth layer can be determined.

Results
GT
[1]
[2]
D^3M

References