Scene Carving: Scene Consistent Image Retargeting

Alex Mansfield[1], Peter Gehler[1], Luc Van Gool[1,2] and Carsten Rother[3]

[1]Computer Vision Laboratory
ETH Zürich, Switzerland

[2]ESAT-PSI
KU Leuven, Belgium

[3]Microsoft Research
Cambridge, UK

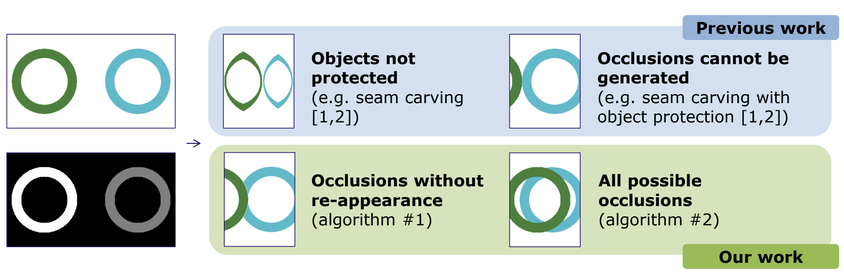
Main Idea

Seam Carving

- Seam carving iteratively removes seams of pixels, minimizing visual distortion using dynamic programming
- Other retargeting methods commonly use image warping, which can be effective but harder to optimize

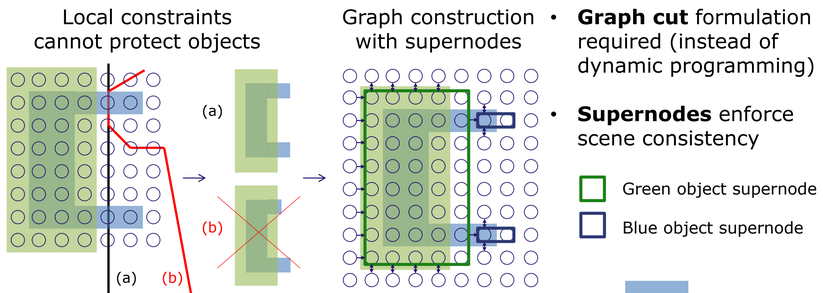
Scene Consistency

1) Objects are protected (i.e. not distorted from original image)
2) Object depth ordering is preserved as in the original image



Our Goal
To extend seam carving to produce the best result subject to scene consistency

#1 "Flat" formulation

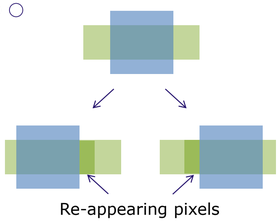


- **Graph cut** formulation required (instead of dynamic programming)
- **Supernodes** enforce scene consistency

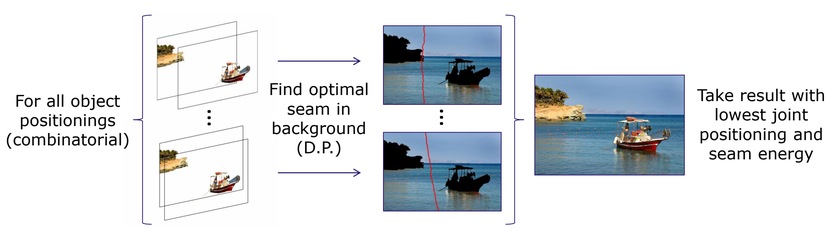
Green object supernode

Blue object supernode

Problem: higher order cliques needed to optimize for re-appearing pixels

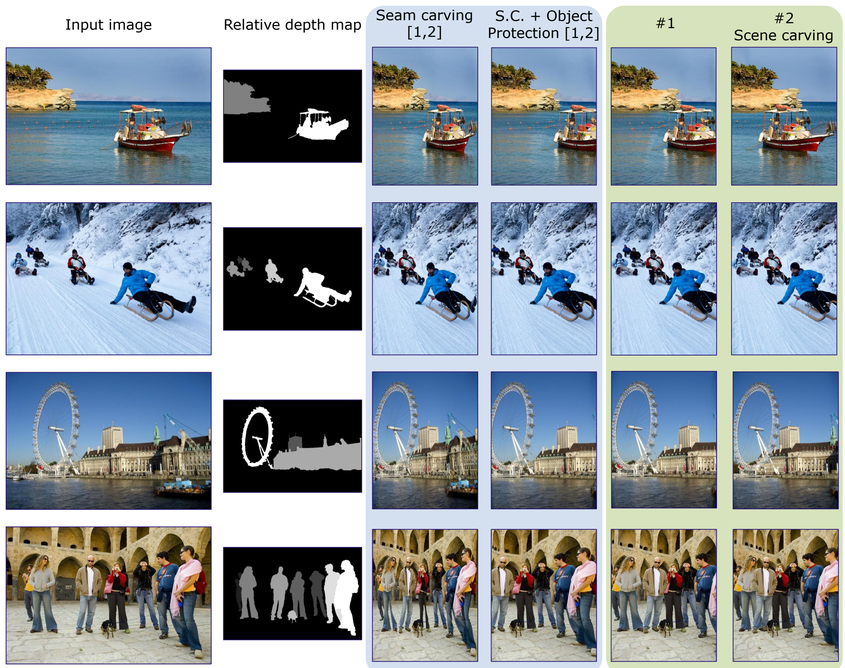


#2 Layered formulation (scene carving)



- **Translate objects** maintaining position or shifting 1 pixel left
  - Propose all combinations
- **Seam carve** in background using **dynamic programming**
  - Energy minimized when:
    - Fewest object pixels occluded
    - Least visual distortion created
    - Most hole pixels removed
  - Subject to constraint:
    - No hole pixels revealed
- Hierarchical speed-up
  - ~36x faster optimization

Results



	Boat	Sledge	London eye	People
No. of objects	2	5	3	8
Size	1016 x 677	1024 x 759	1024 x 683	640 x 427
No. seams removed	500	500	500	300
Seam carving [1]	64 s	62 s	49 s	22 s
S.C. + Obj. Prot. [1]	54 s	69 s	60 s	28 s
#1	19941 s	46152 s	2079 s	4515 s
#2 Scene Carving	619 s	596 s	711 s	352 s

Time taken
to produce our results with our Matlab/Mex implementation

References

[1] Avidan, S. and Shamir, A. 'Seam carving for content-aware image resizing' SIGGRAPH 2007
[2] Rubinstein, M., Shamir, A., Avidan, S. 'Improved seam carving for video retargeting' SIGGRAPH 2008