

# Supplementary Material on “Multi-Operator Image Retargeting with Automatic Integration of Direct and Indirect Seam Carving”

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## Abstract

This supplement provides additional material to support the work in the paper. Apart from some background material regarding the proposed multi-operator scheme, the supplement includes paired *t*-test results on our method and other three state-of-the-art methods (CR [1], SV [2], MultiOp [3]), and experimental results to support the proposed *ACESC* has better performance compared with backward [4] and forward [5] energy seam carving.

## I. ACESC COMPARED WITH BACKWARD/FORWARD ENERGY SEAM CARVING

We do not offer many results showing the improvements of *ACESC* over the classical *SC* methods in the paper for the limitation of space. Here we add some comparison results among *ACESC*, forward energy and backward energy *SC* methods. As shown in the figure, the classical *SC* results produce obvious artifacts while our *ACESC* generates satisfactory results.

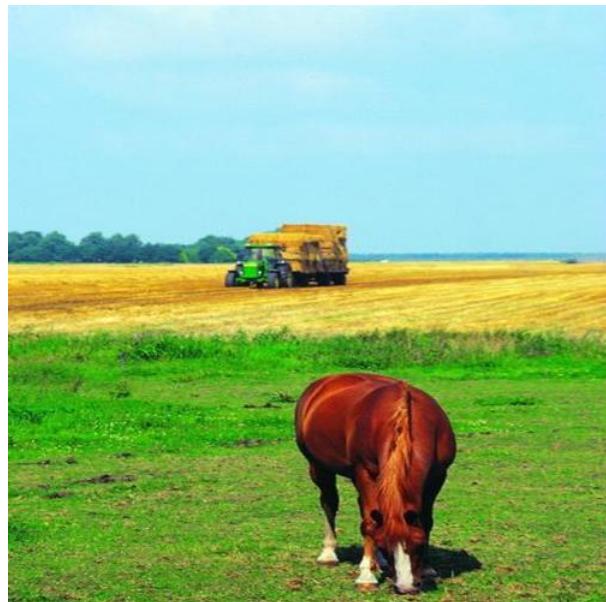
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TABLE I

WITH THE SIGNIFICANCE LEVEL OF 5%, THE P-VALUE OF THE PAIRED T-TEST RESULTS IN SIX DIFFERENT ATTRIBUTES AND TOTAL IMAGES FOR FOUR IMAGE RETARGETING METHODS. THE P-VALUE IN BOLD TYPE INDICATES A REJECTION OF THE NULL HYPOTHESIS AT THE 5% SIGNIFICANCE LEVEL, WHICH MEANS THERE IS SIGNIFICANT DIFFERENCE BETWEEN THE TWO METHODS.

	CR	SV	MULTIOP	Ours
Global				
CR	1.0000	0.6771	0.2468	0.6002
SV	0.6771	1.0000	0.5084	0.9570
MULTIOP	0.2468	0.5084	1.0000	0.4893
Ours	0.6002	0.9570	0.4893	1.0000
lines/edges				
CR	1.0000	0.8676	0.1773	0.2945
SV	0.8676	1.0000	0.1736	0.3550
MULTIOP	0.1773	0.1736	1.0000	0.7284
Ours	0.2945	0.3550	0.7284	1.0000
faces/people				
CR	1.0000	0.0378	0.1830	0.0627
SV	<b>0.0378</b>	1.0000	0.4157	0.9584
MULTIOP	0.1830	0.4157	1.0000	0.3717
Ours	0.0627	0.9584	0.3717	1.0000
foreground objects				
CR	1.0000	0.6060	0.2497	0.4190
SV	0.6060	1.0000	0.8360	0.8176
MULTIOP	0.2497	0.8360	1.0000	0.9518
Ours	0.4190	0.8176	0.9518	1.0000
geometric structures				
CR	1.0000	0.4765	0.4020	0.5814
SV	0.4765	1.0000	0.0857	0.6750
MULTIOP	0.4020	0.0857	1.0000	0.1328
Ours	0.5814	0.6750	0.1328	1.0000
symmetry				
CR	1.0000	0.0853	0.9079	0.2322
SV	0.0853	1.0000	0.1391	<b>0.0030</b>
MULTIOP	0.9079	0.1391	1.0000	0.1161
Ours	0.2322	0.0030	0.1161	1.0000
texture				
CR	1.0000	0.3789	0.1332	0.1553
SV	0.3789	1.0000	0.7096	0.8273
MULTIOP	0.1332	0.7096	1.0000	0.4498
Ours	0.1553	0.8273	0.4498	1.0000



input



backward



forward



ACESC



input



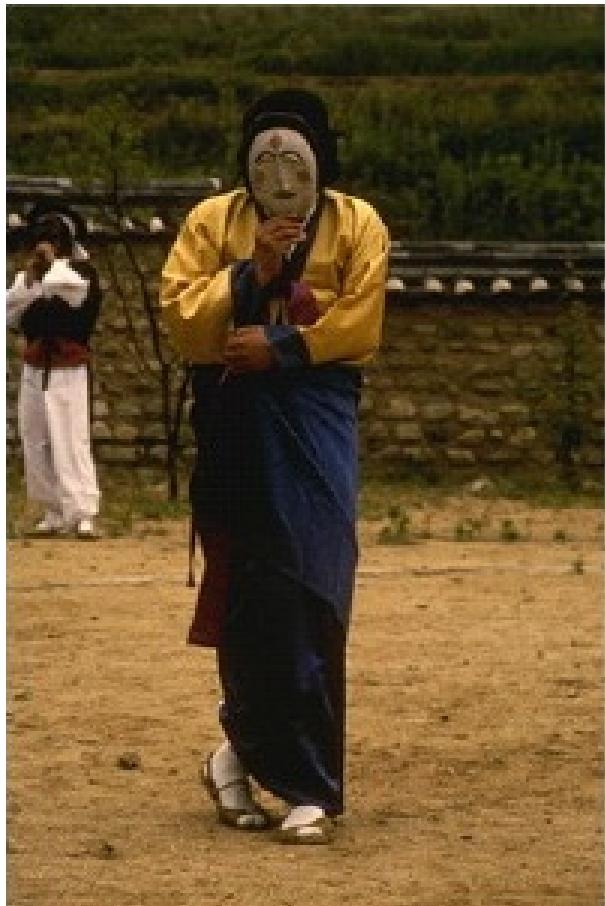
backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



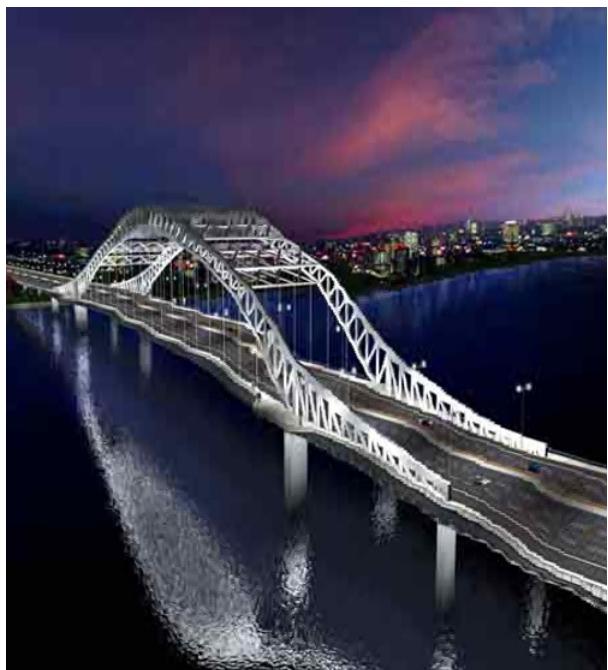
ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC



input



backward



forward



ACESC

## REFERENCES

- [1] M. Rubinstein, D. Gutierrez, O. Sorkine, and A. Shamir, “A comparative study of image retargeting,” *ACM Transactions on Graphics*, vol. 29, no. 5, 2010.
- [2] P. Krähenbühl, M. Lang, A. Hornung, and M. Gross, “A system for retargeting of streaming video,” *ACM Trans. Graph.*, vol. 28, pp. 126:1–126:10, December 2009.
- [3] M. Rubinstein, A. Shamir, and S. Avidan, “Multi-operator media retargeting,” *ACM Transactions on Graphics*, vol. 28, no. 3, 2009.
- [4] S. Avidan and A. Shamir, “Seam carving for content-aware image resizing,” *ACM Transactions on Graphics*, vol. 26, no. 3, 2007.
- [5] M. Rubinstein, A. Shamir, and S. Avidan, “Improved seam carving for video retargeting,” *ACM Transactions on Graphics*, vol. 27, no. 3, 2008.