

CSCI 5561

Group 3

Semantic-Aware

Image Retargeting

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Introduction:

Traditional seam carving uses gradients only, destroying important subjects. We combine three foundation models like RGB-VST, Depth Anything 3 and DINOv3 to create composition-aware energy functions that intelligently preserve content across 10 composition types.

Input-Output:

RGB image + target dimensions



Retargeted image with preserved subjects

Task: Resize images to any aspect ratio while preserving subjects, structure, and composition

Framework Details:

$$E = w_g \cdot |\nabla I| + w_d \cdot |\nabla D| + w_s \cdot T_{sal} + w_c \cdot T_{class}$$

∇I : Image gradient
 ∇D : Depth gradient
 T_{sal} : Saliency term
 T_{class} : Composition class intensity

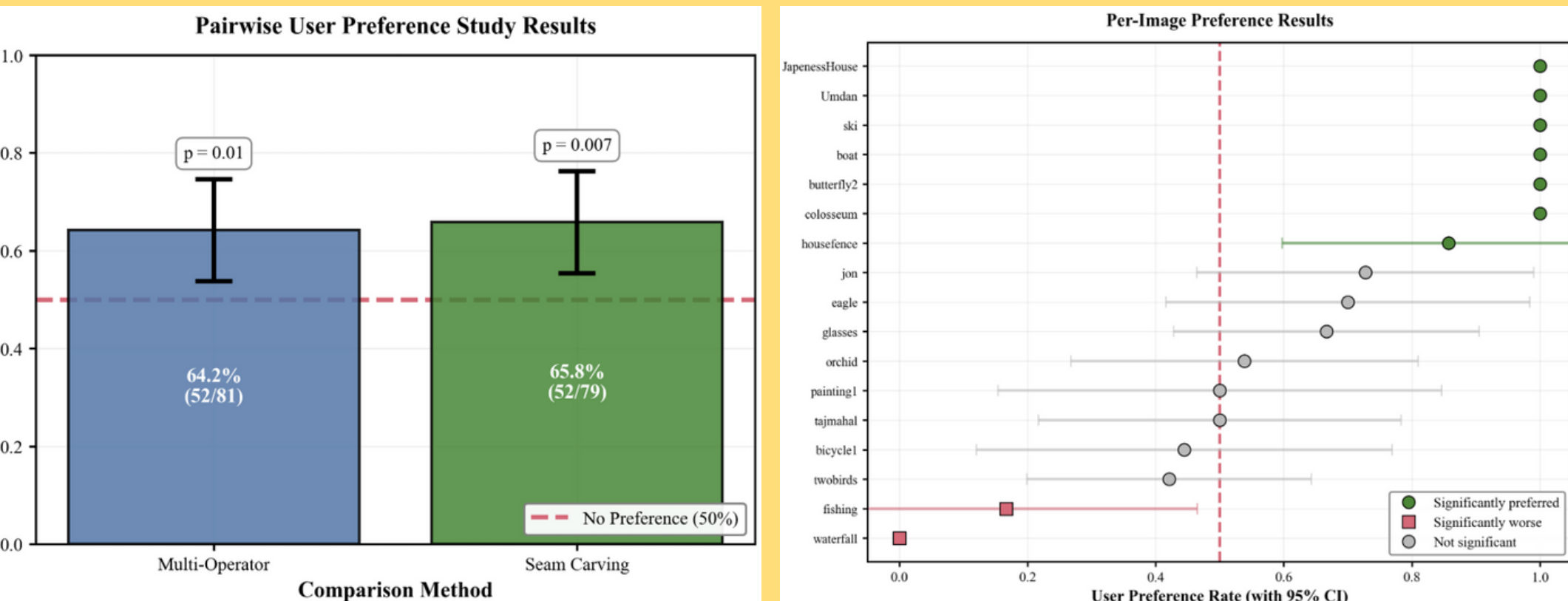
- | | |
|---------------------------------|------------------------|
| Signal Extraction | Multi-Operator Planner |
| • VST Saliency (RGB) | • Seam Carving |
| • DA3 Depth Map | • Cropping |
| • DINOv3 Composition Classifier | • Scaling |
| | • Hybrid strategies |

Dataset Information:

- Dataset: RetargetMe benchmark (80 images)

Evaluation: What did we experiment on?

- 15-image pairwise survey comparing our retargeted outputs against Seam Carving and Multi-Operator.
- Our method outperformed both baselines, winning 70.7% of comparisons against Seam Carving and 65.7% against Multi-Operator.



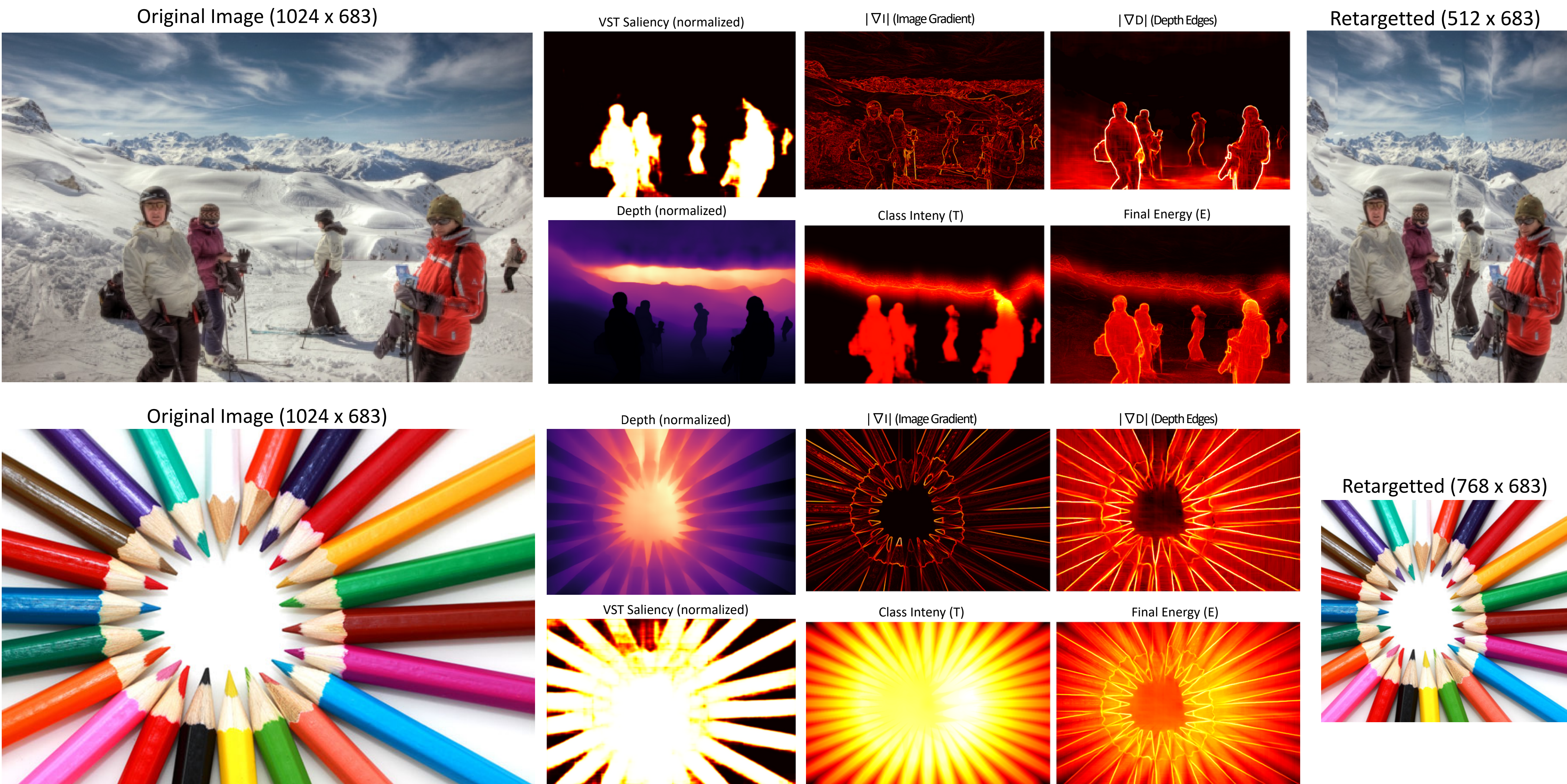
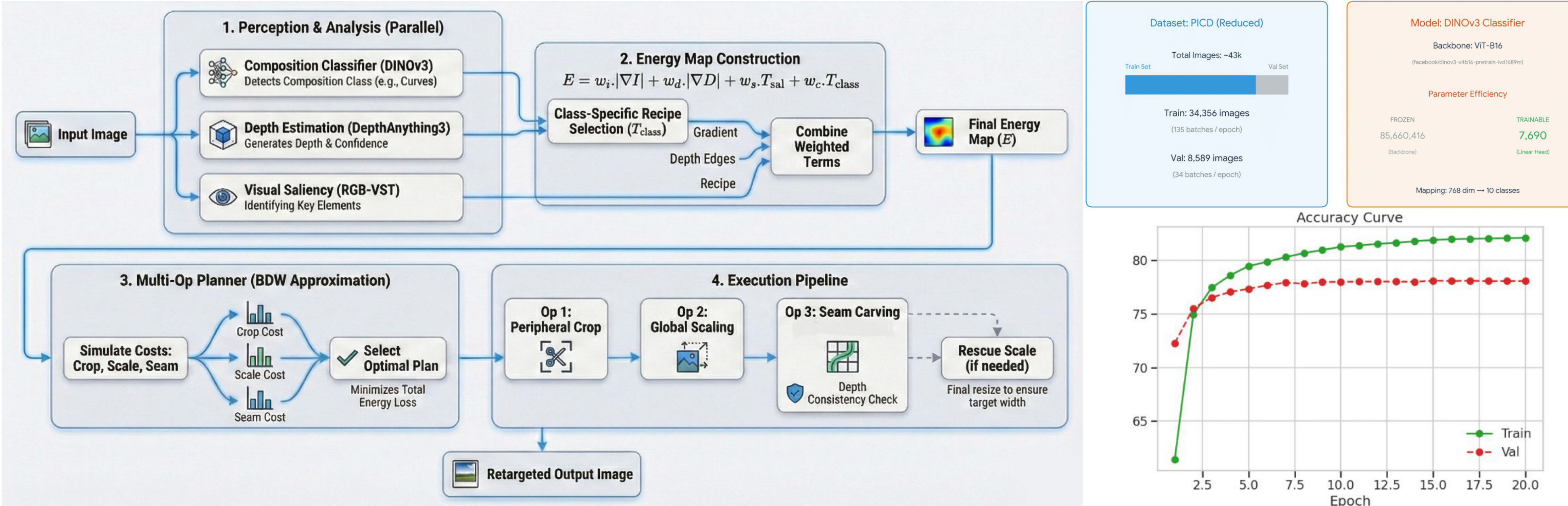
References:

[1] Avidan & Shamir, Seam Carving, SIGGRAPH 2007.
[2] Rubinstein et al., Multi-Operator Retargeting, SIGGRAPH2009.
[3] Cao et al., Depth-Anything 3, 2024.
[4] Oquab et al., DINOv3, 2023.
[5] Rubinstein et al., RetargetMe Dataset, TOG 2010.
[6] Zhao et al., Can Machines Understand Composition?, 2025.

Semantic Energy Functions for Smart Image Retargeting

Our system uses saliency, depth, composition, and segmentation to preserve important content while resizing images.

Pipeline Flow Chart and Methodology



Class	Original Image	Seam Carving Results	Our results
Horizontal			
Curves			