Image Analogies
SIGGRAPH 2001

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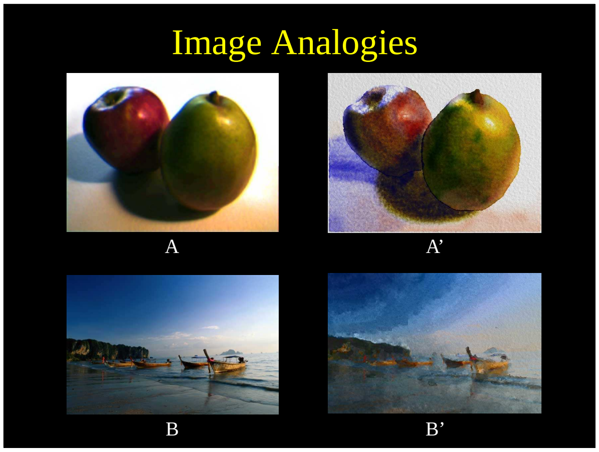


Image Analogies

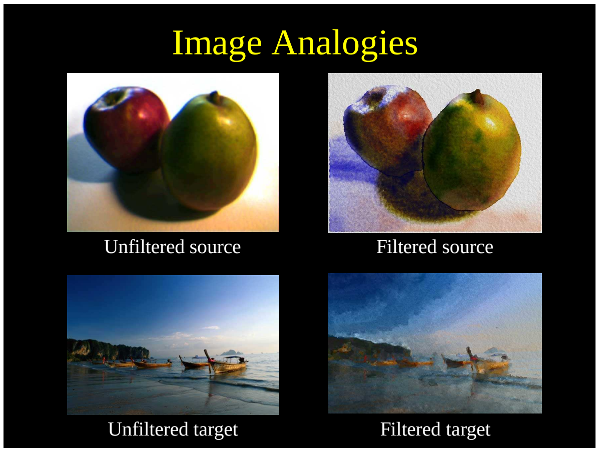
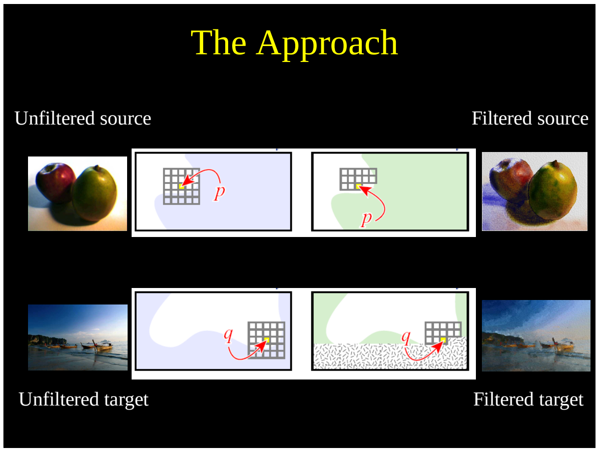
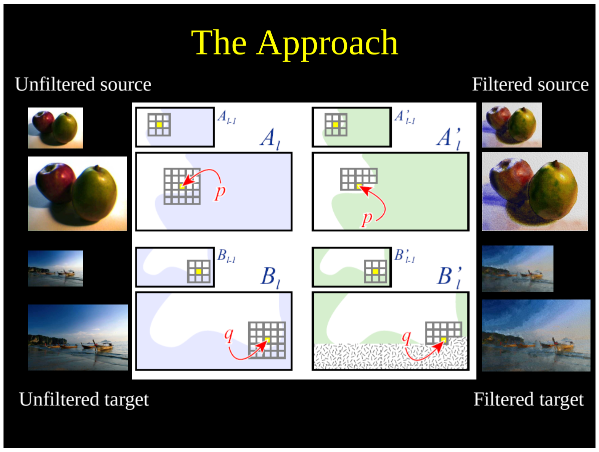


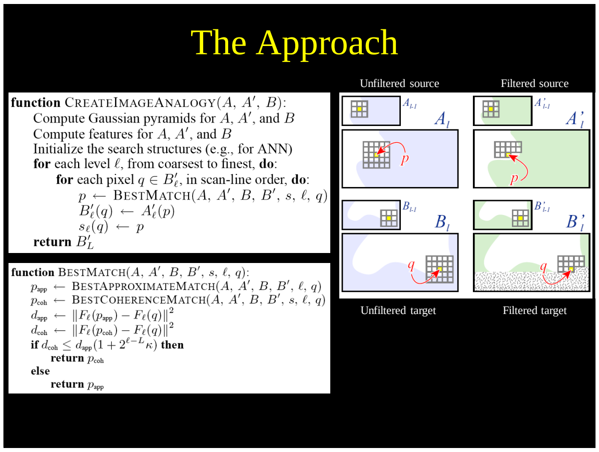
Image Analogies



The Approach



The Approach



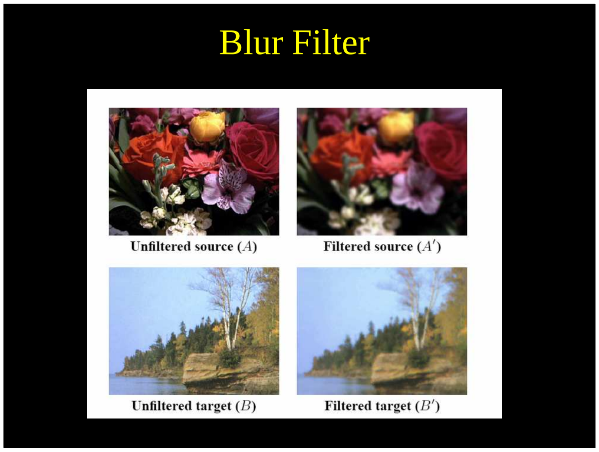
The Approach

```
function CREATEIMAGEANALOGY($A$, $A'$, $B$):
    Compute Gaussian pyramids for $A$, $A'$, and $B$
    Compute features for $A$, $A'$, and $B$
    Initialize the search structures (e.g., for ANN)
    for each level $\ell$, from coarsest to finest, do:
        for each pixel $q \in B'_\ell$, in scan-line order, do:
            $p \leftarrow$ BESTMATCH($A$, $A'$, $B$, $B'$, $s$, $\ell$, $q$)
            $B'_\ell(q) \leftarrow A'_\ell(p)$
            $s_\ell(q) \leftarrow p$
    return $B'_L$
```

```
function BESTMATCH($A$, $A'$, $B$, $B'$, $s$, $\ell$, $q$):
    $p_{app} \leftarrow$ BESTAPPROXIMATEMATCH($A$, $A'$, $B$, $B'$, $\ell$, $q$)
    $p_{coh} \leftarrow$ BESTCOHERENCEMATCH($A$, $A'$, $B$, $B'$, $s$, $\ell$, $q$)
    $d_{app} \leftarrow \|F_\ell(p_{app}) - F_\ell(q)\|^2$
    $d_{coh} \leftarrow \|F_\ell(p_{coh}) - F_\ell(q)\|^2$
    if $d_{coh} \leq d_{app}(1 + 2^{\ell - L}\kappa)$ then
        return $p_{coh}$
    else
        return $p_{app}$
```

Implementation Details

- Use approximate nearest neighbor search and Ashikhmin's *coherence search* heuristic
- Use *feature vectors* instead of pixel values
  - Feature vector can consist of RGB values plus additional "channels" such as luminance, outputs of derivative filters
- *Luminance remapping* to align color histograms of source and target images



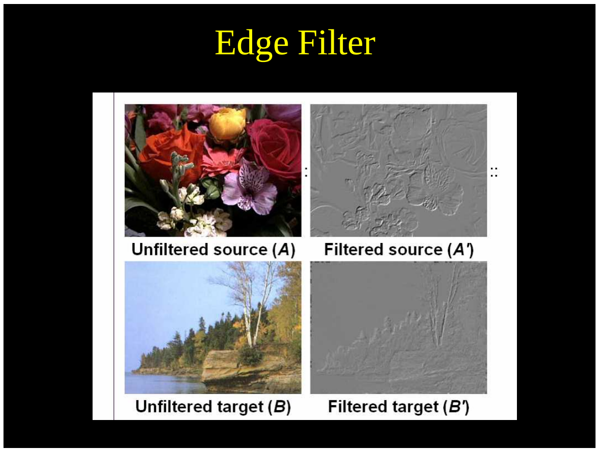
Blur Filter

Unfiltered source (A)

Filtered source (A')

Unfiltered target (B)

Filtered target (B')



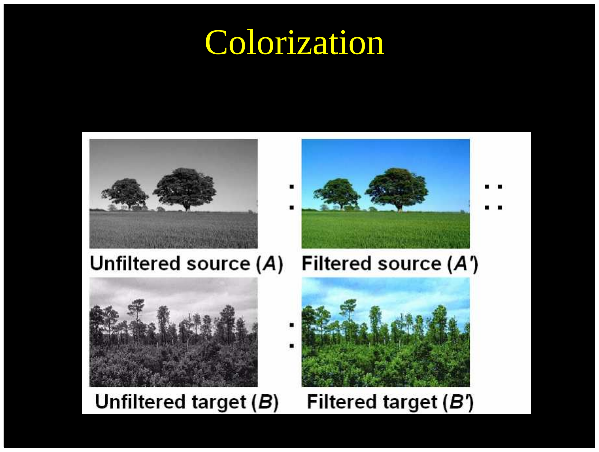
Edge Filter

Unfiltered source (*A*)

Filtered source (*A'*)

Unfiltered target (*B*)

Filtered target (*B'*)



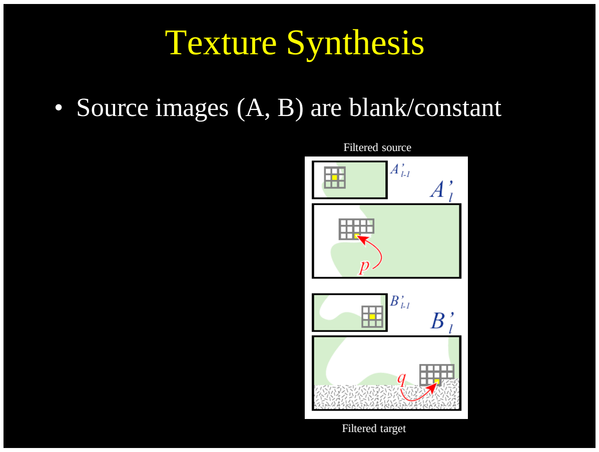
Colorization

Unfiltered source (*A*)

Filtered source (*A'*)

Unfiltered target (*B*)

Filtered target (*B'*)

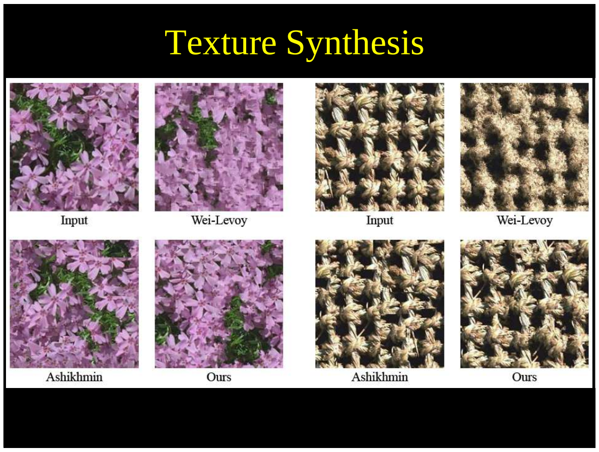


Texture Synthesis

- Source images (A, B) are blank/constant

Filtered source

Filtered target



Texture Synthesis

Input

Wei-Levoy

Input

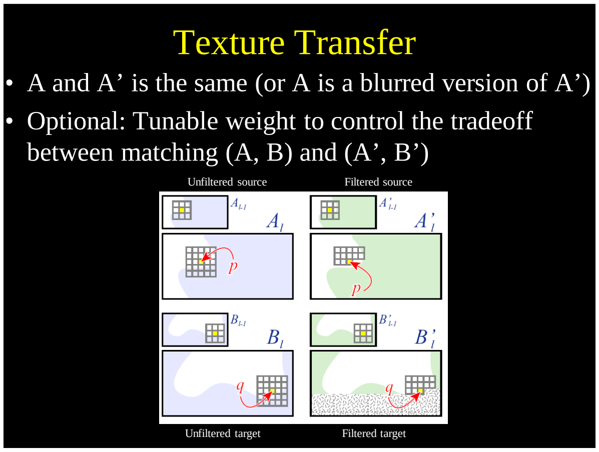
Wei-Levoy

Ashikhmin

Ours

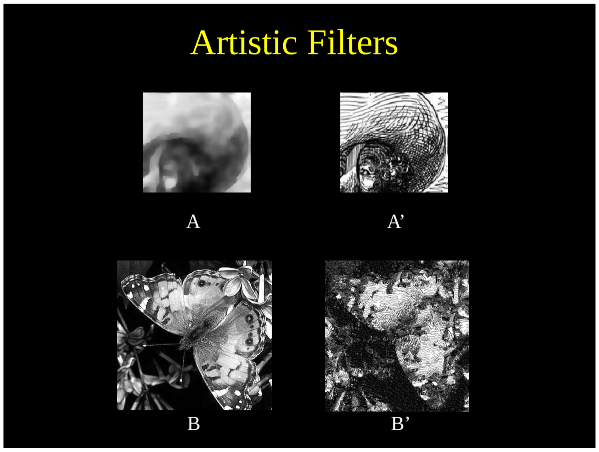
Ashikhmin

Ours

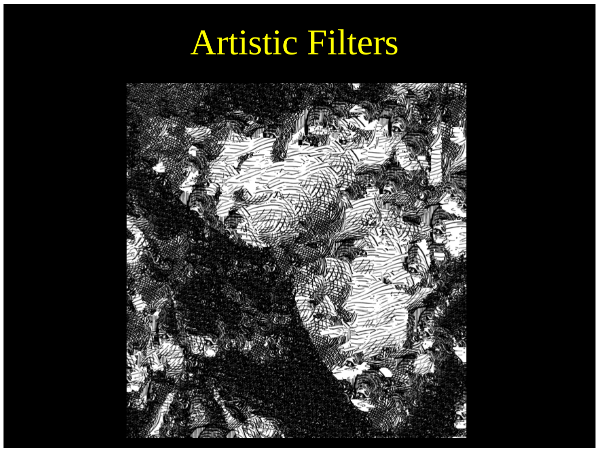


Texture Transfer

- A and A’ is the same (or A is a blurred version of A’)
- Optional: Tunable weight to control the tradeoff between matching (A, B) and (A’, B’)



Artistic Filters



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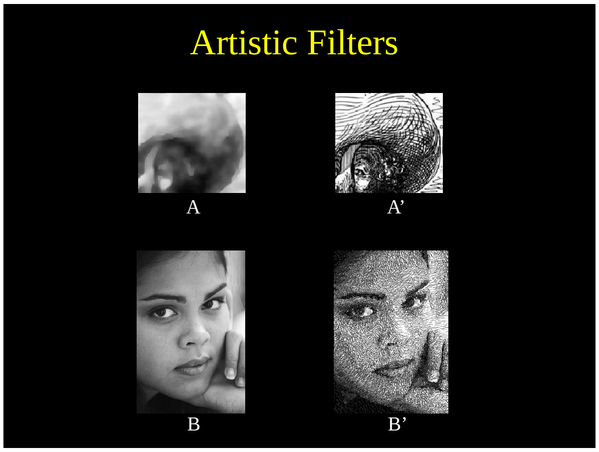
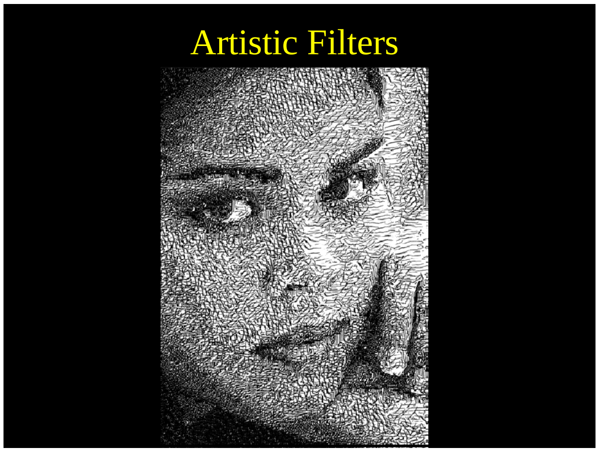


Artistic Filters



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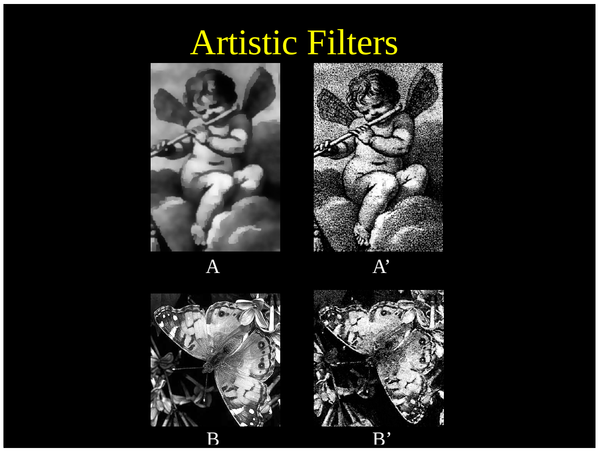

Artistic Filters

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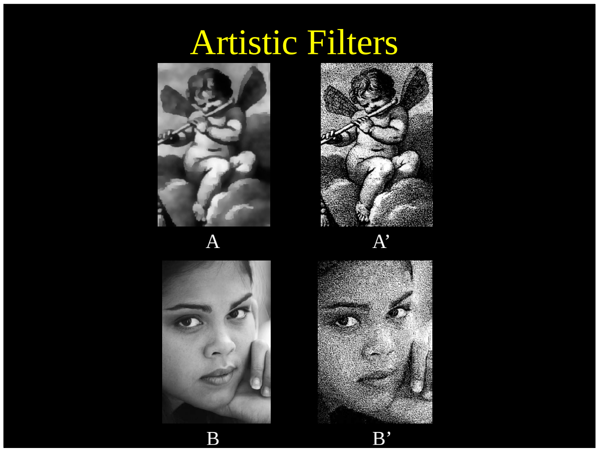

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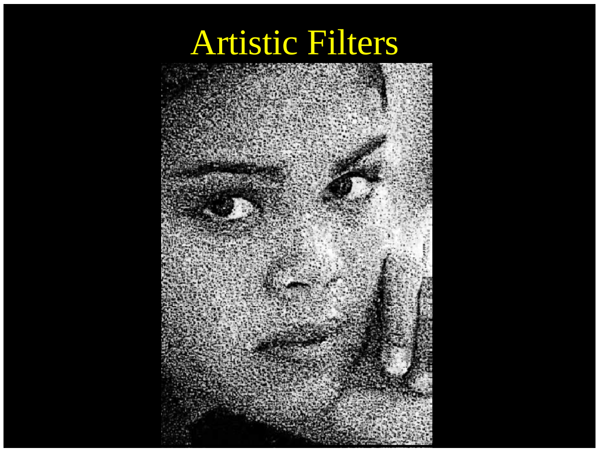
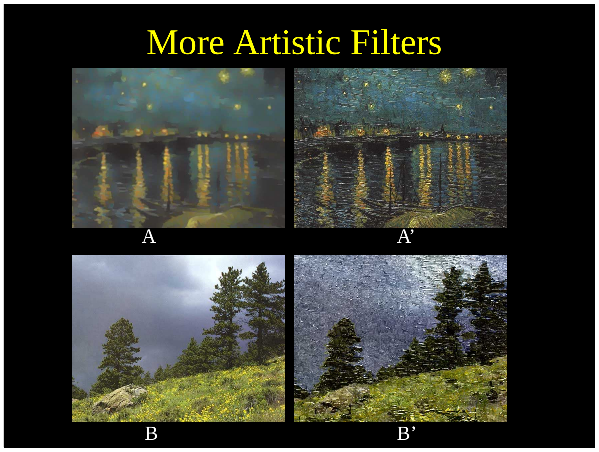
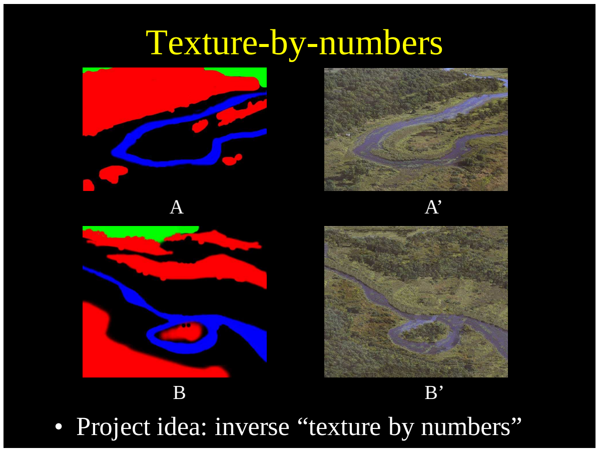


Artistic Filters

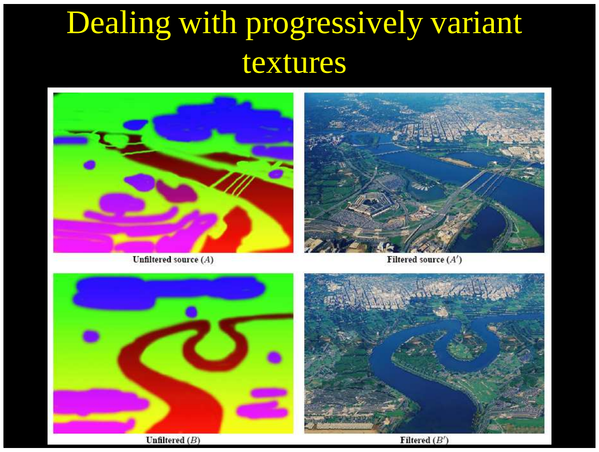


More Artistic Filters

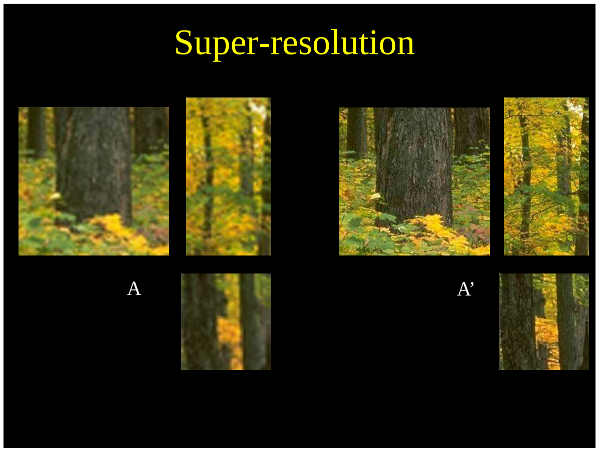


Texture-by-numbers

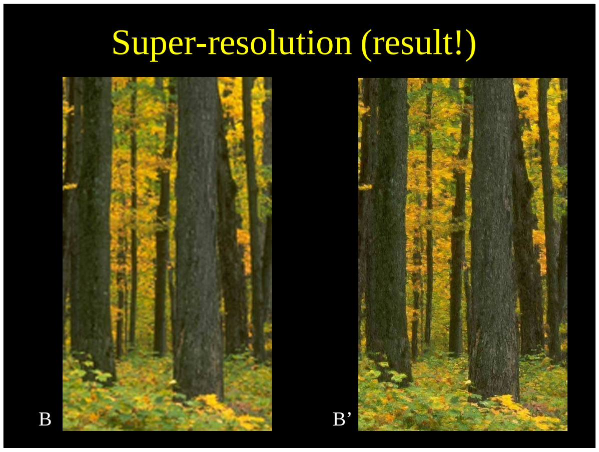
- Project idea: inverse “texture by numbers”



Dealing with progressively variant textures



Super-resolution



Super-resolution (result!)