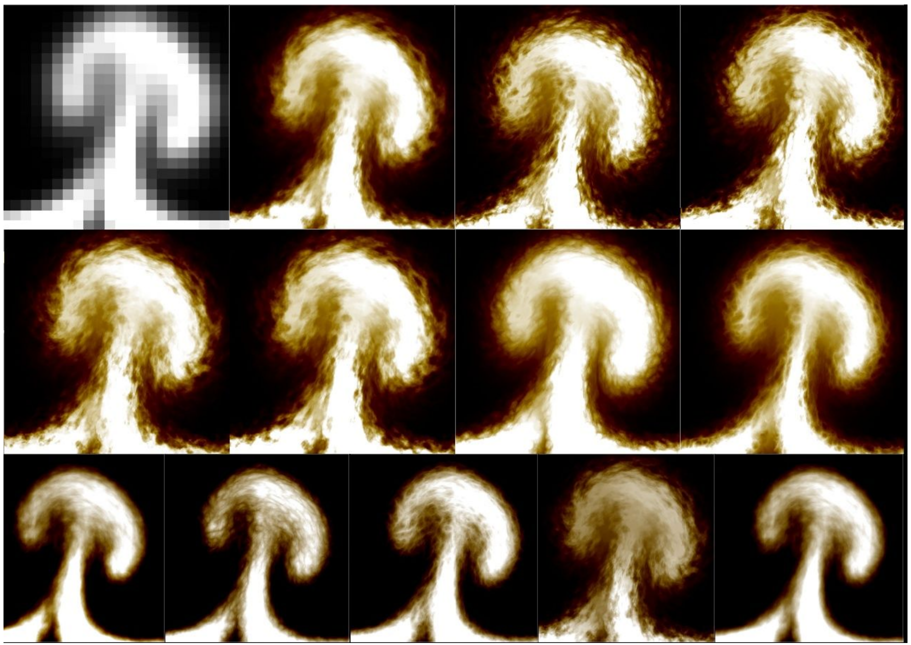
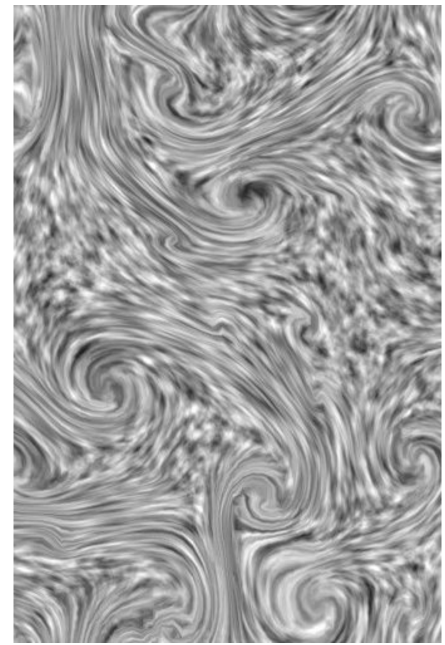
Blending, interpolating, synthesizing textures





Fabrice NEYRET ***24 March 2016***

Blend / interp: ***Which space is ‘linear’ ?***

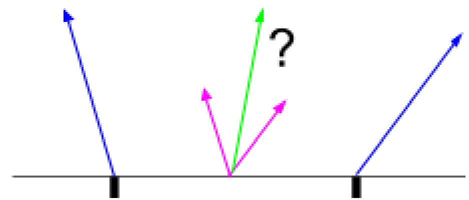
RGB or HLS or XYZ ? (which color space ? which gamma ?) I, E or magnitude ?

Lean: σ or σ^2 ? $interp(\sigma^2) \neq interp(\sigma)^2$ Flakes ellipsoids: Q or $\Sigma\ (= \frac{1}{Q})$?

Voxels: A, T, density ?

Never: fields of (u,v), angles , phase (when wraps)

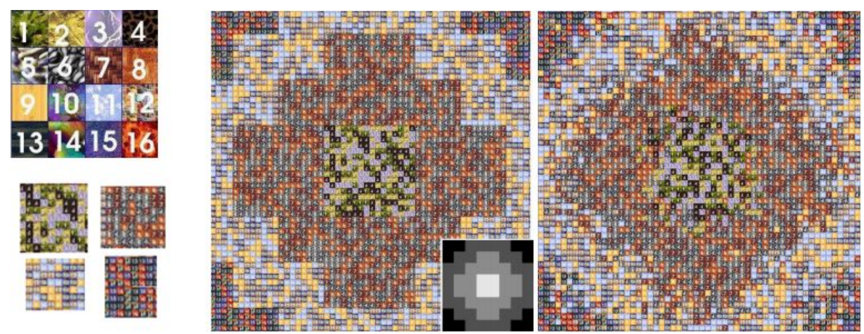
Issues: vectors



Raster or vector ? / Eulerian or Lagrangian ?

(BRDF: SH vs morphing...)

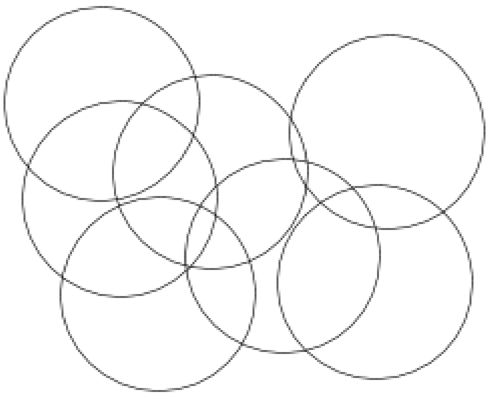
Raw data vs indirect
(high level handle):
histogram, probability...



[paper]

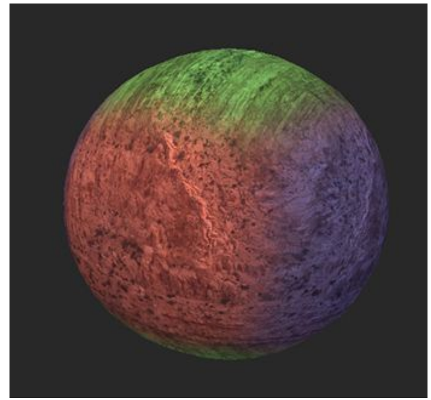
Blending / splatting sprites or layers

Sprites / splats (/ brushes)



Contrast = σ .

Triplanar mapping



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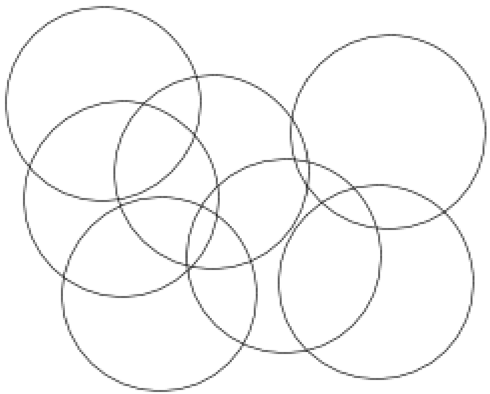

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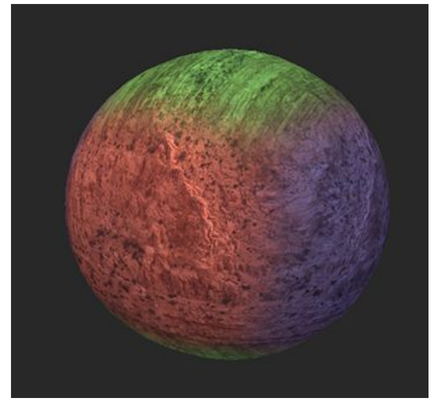


Contrast = σ .

$$\sigma^2(\alpha C_0 + \bar{\alpha} C_1) = E((\alpha C_0 + \bar{\alpha} C_1)^2) - E^2(\alpha C_0 + \bar{\alpha} C_1) = \alpha^2 \sigma_0{}^2 + \bar{\alpha}^2 \sigma_1{}^2 = (\alpha^2 + \bar{\alpha}^2)\sigma^2 \neq \sigma^2$$

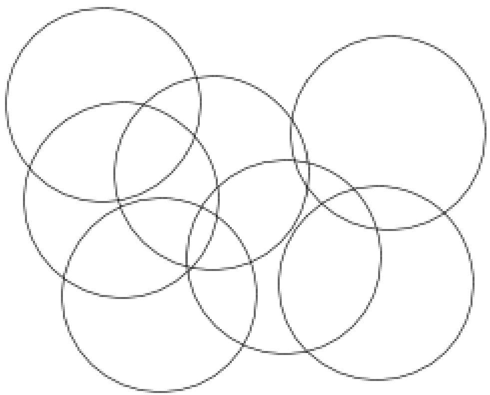
$$\sigma^2(\Sigma\, \alpha_i\, C_i) = (\Sigma\, \alpha_i{}^2)\, \sigma^2$$

H: non correlated *H: same stats*

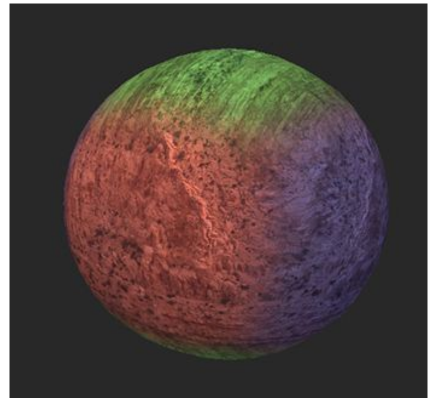
$\rightarrow \sigma(\frac{1}{N} \sum C_i) = \frac{\sigma}{\sqrt{N}}$ NB: is law of large number : convergence to avg. (cf path tracing :-))

Blending / splatting sprites or layers

Sprites / splats



Triplanar mapping



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$\sigma^2(\Sigma\, \alpha_i\, C_i) = (\Sigma\, \alpha_i{}^2)\, \sigma^2$ *H: non correlated* *H: same stats*

$\rightarrow\ \sigma(\frac{1}{N} \sum C_i) = \frac{\sigma}{\sqrt{N}}$ NB: is law of large number : convergence to avg. We want σ !

Solution: make blending coefs such that $\Sigma\, \alpha_i{}^2 = 1$ [paper]

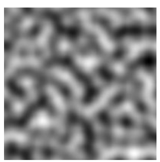
$\rightarrow$ simply normalized weights α_i by $\sqrt{\Sigma\, \alpha_i{}^2}$! (Indeed, $\bar{C} + \frac{Lerp(C_i - \bar{C})}{\sqrt{\Sigma\, \alpha_i{}^2}}$) [shadertoy][2]

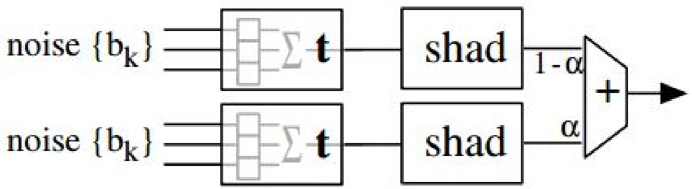
Blending / splatting structured pattern

Procedural , non-linear transform (clamp, LUT…) : *naive blend → ghosting artefacts !*

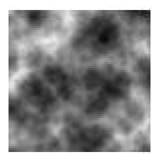
$\sum$

→





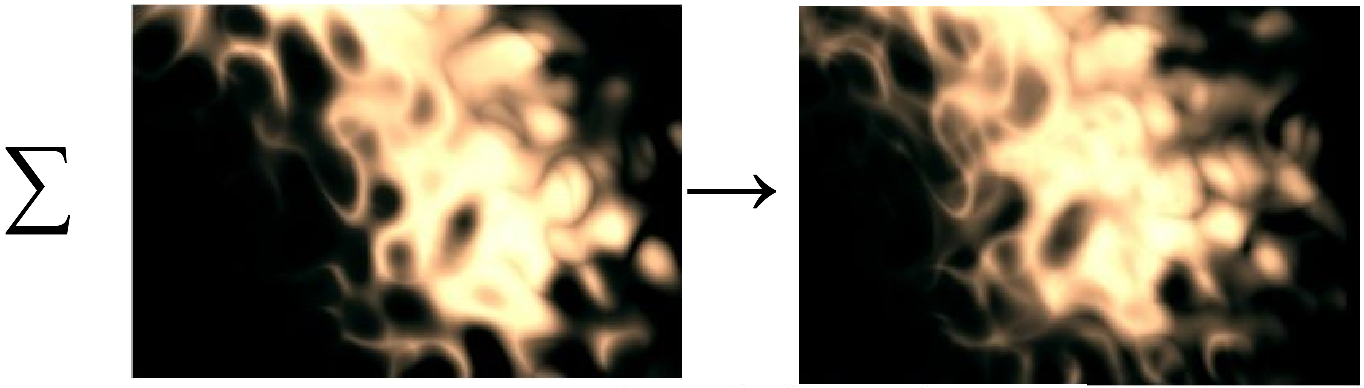
Non-linear: abs, shad

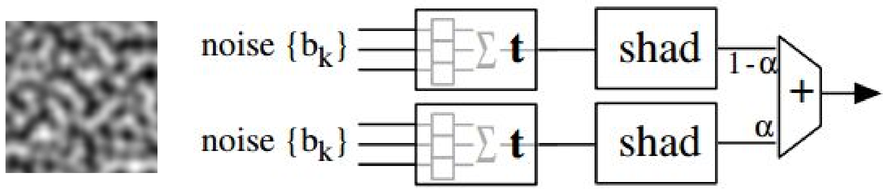


Solution between two images: morphing (disto mapping). won't apply to procedural, + issues.

Blending / splatting structured pattern

Procedural , non-linear transform (clamp, LUT…) : *naive blend → ghosting artefacts !*





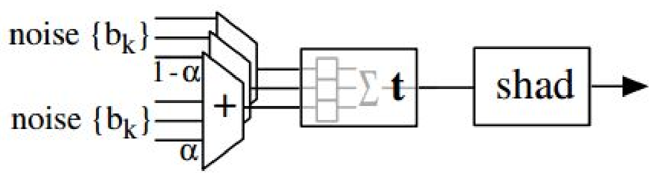
Non-linear: abs, shad

Solution: Deferred non-linear part

+ save some cost :-)

NB:

not only for procedural !



[paper]

[shadertoy] [with advection]

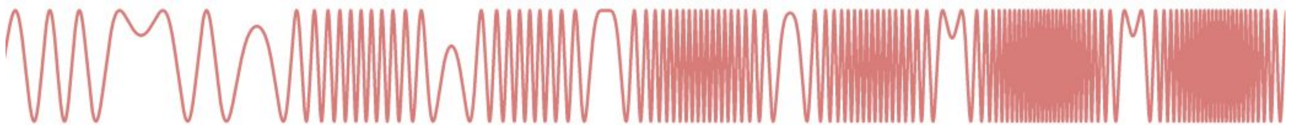
Space-Interpolating procedural param

Want to modify the frequency of *noise(freq*x)* or *sin(freq*x)* along space ? or *sound(t)*

Bad idea: just replace *freq* by *freq(x)*

Expected:

Obtained:



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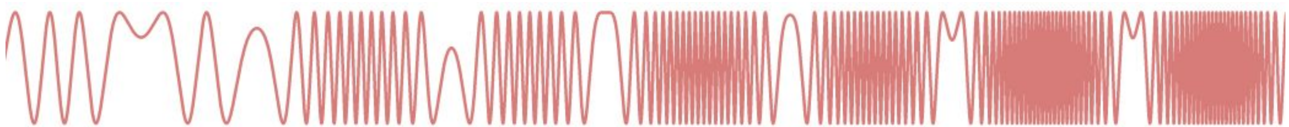


What you want is *LUT(phase)*, with $\frac{\partial phase}{\partial x} = freq(x)$

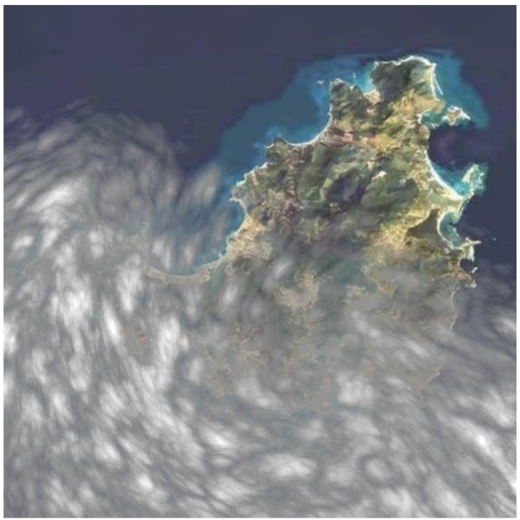
$$\rightarrow phase = \int_0^x \frac{\partial phase}{\partial x}$$

(if *freq* is constant, is does give *phase = freq.x*)

[shadertoy sin]   [shadertoy noise]   [desmos graph]

Lookdev ⊥ mapping distortions

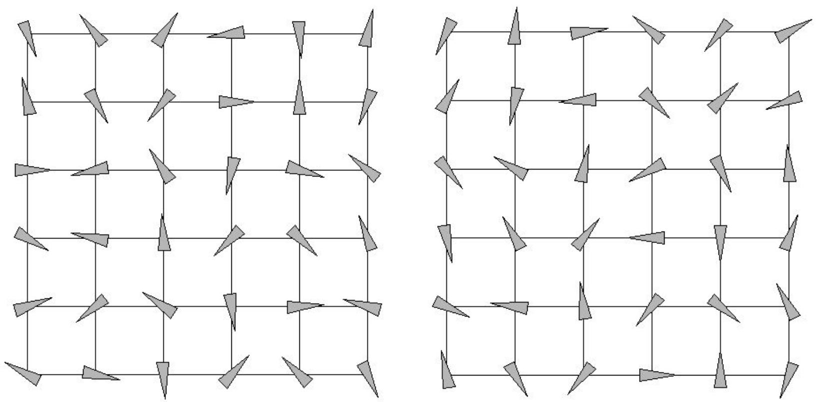
Texture advection, painterly animation… : keep the look despite distortions
Paradoxical requirements !

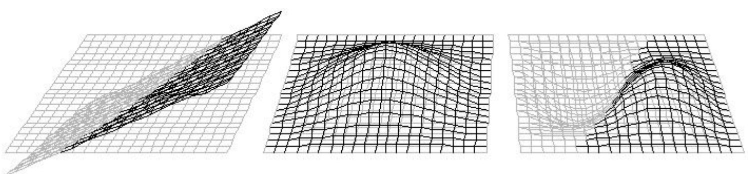


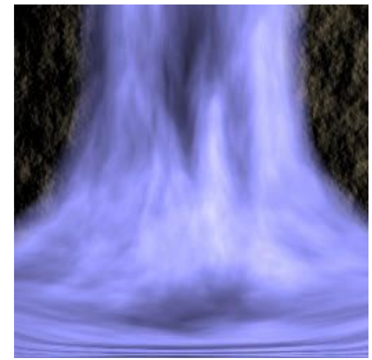
Lookdev ⊥ mapping distortions

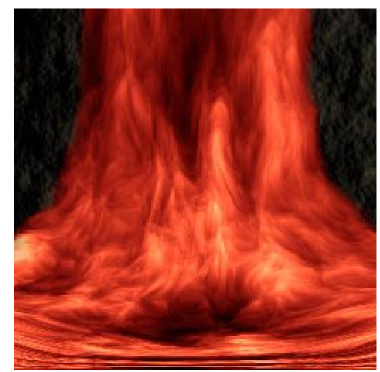
Texture advection, painterly animation… : keep the look despite distortions
Paradoxical requirements !

Flow noise: time ⊥ space [URL1, URL2] [shadertoy]

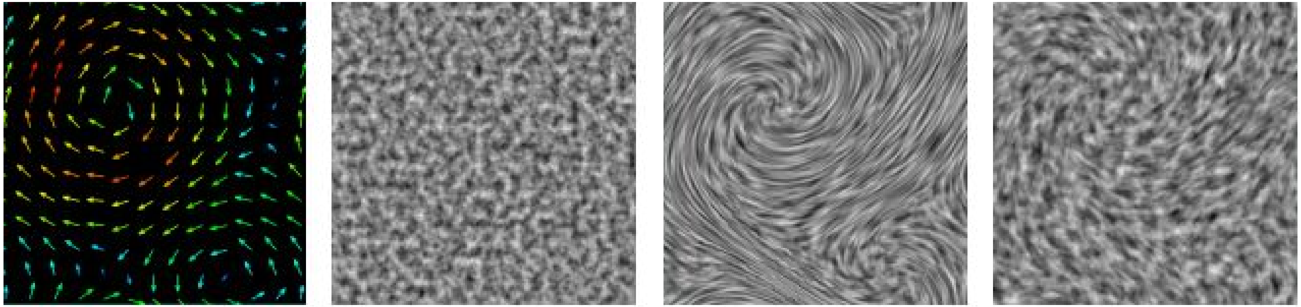






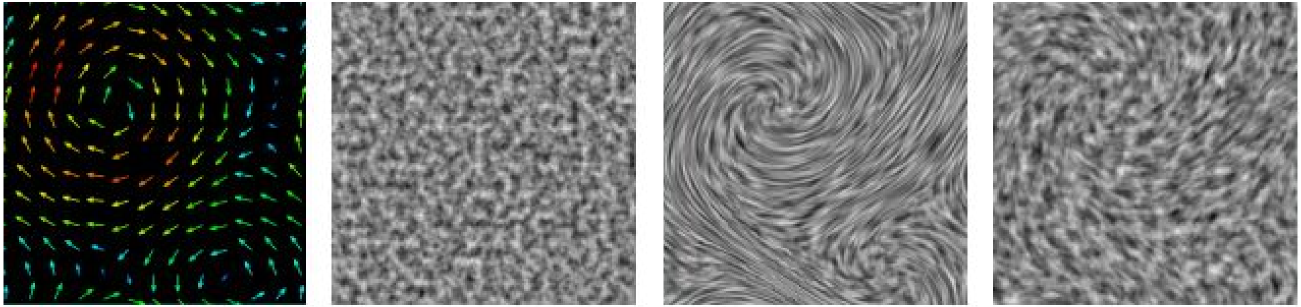


Texture advection



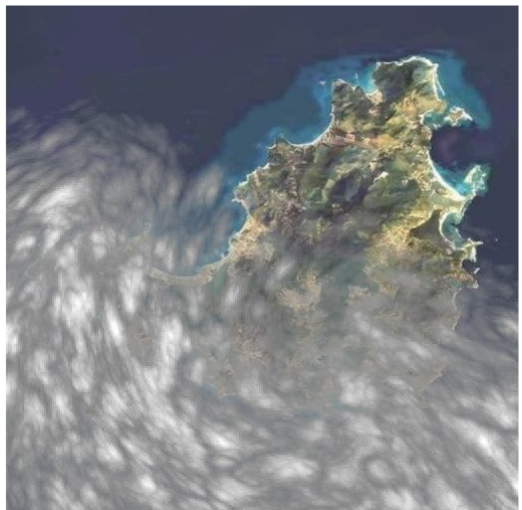
(a) Velocity field (b) Input texture (d) Naïve algorithm (c) Our algorithm

Texture advection



(a) Velocity field | (b) Input texture | (d) Naïve algorithm | (c) Our algorithm

- + Procedural
- + Flownoise



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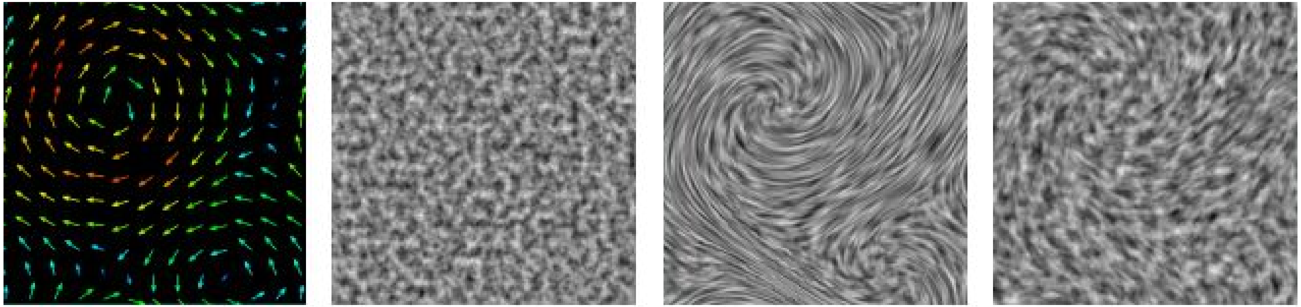
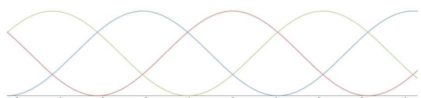


(a) Velocity field (b) Input texture (d) Naïve algorithm (c) Our algorithm

Idea: regeneration if disto.

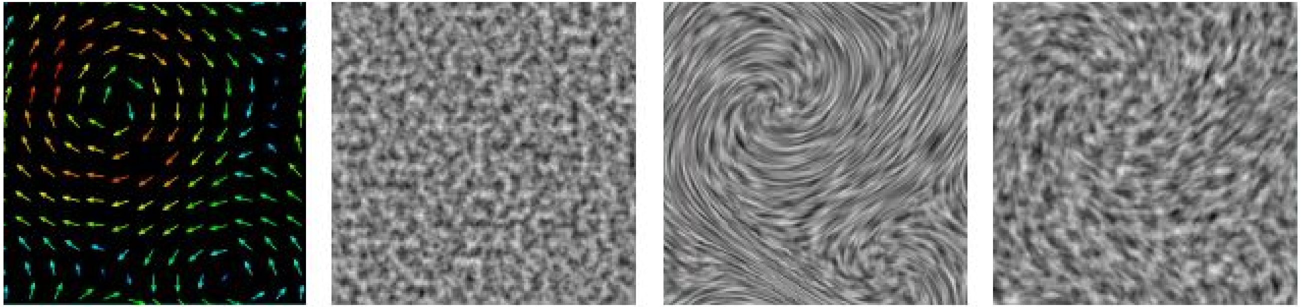
Eulerian way:

- 3-phased regenerated layer:

  [shadertoy] 

  “motion without movement” illusion   + contrast preservation

Texture advection



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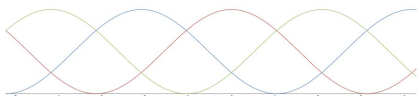
Eulerian way: [papers: Eulerian]

- 3-phased regenerated layer:

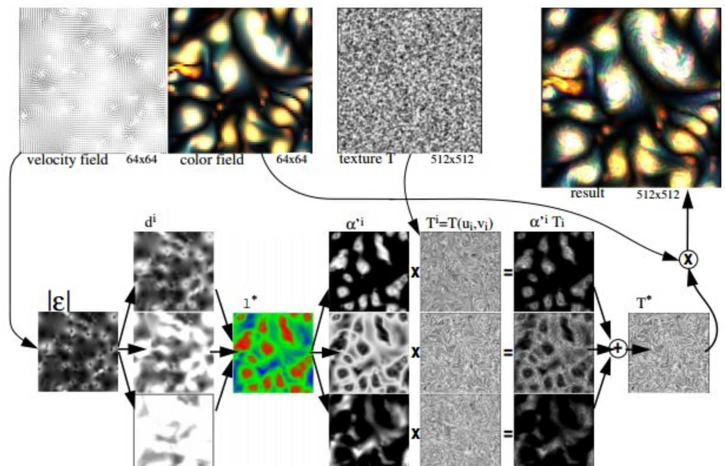
  [shadertoy]



- Layers per duration (~ v-MIPmap) & masks

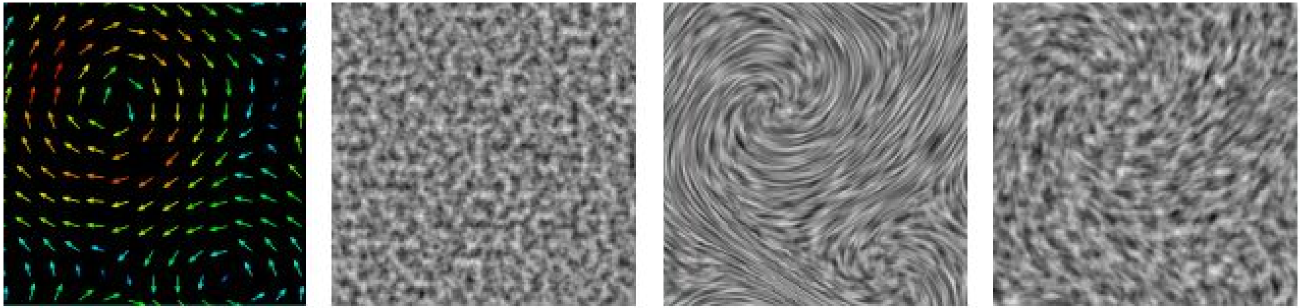
- Variant: time bidir in optical flow.

  [video Watercolor] [paper]



Texture advection

[papers: Eulerian, Lagrangian]



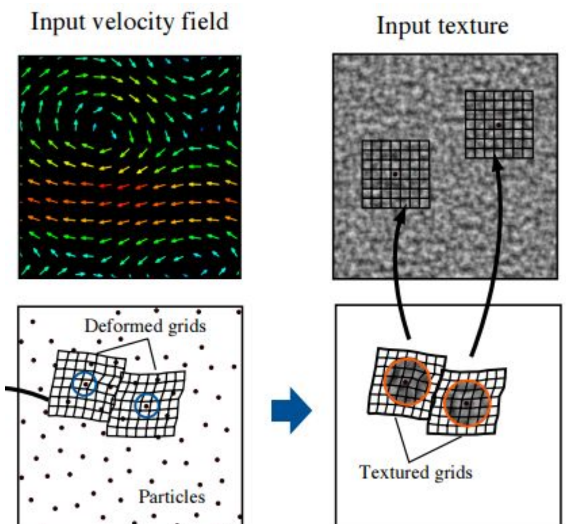
(a) Velocity field (b) Input texture (d) Naïve algorithm (c) Our algorithm

Idea: regeneration if disto

Lagrangian way:

Advect sprites

[video QY]



Other pattern conservations

- Motion without movement : [shadertoy]
- Seamless infinite/cyclic zoom : [shadertoy]
- Perceptions of order in noise: motion, 2, xor, symmetries, correlation…
- All-scale unit-integral noise: [shadertoy]

Details respect context
conserve something else

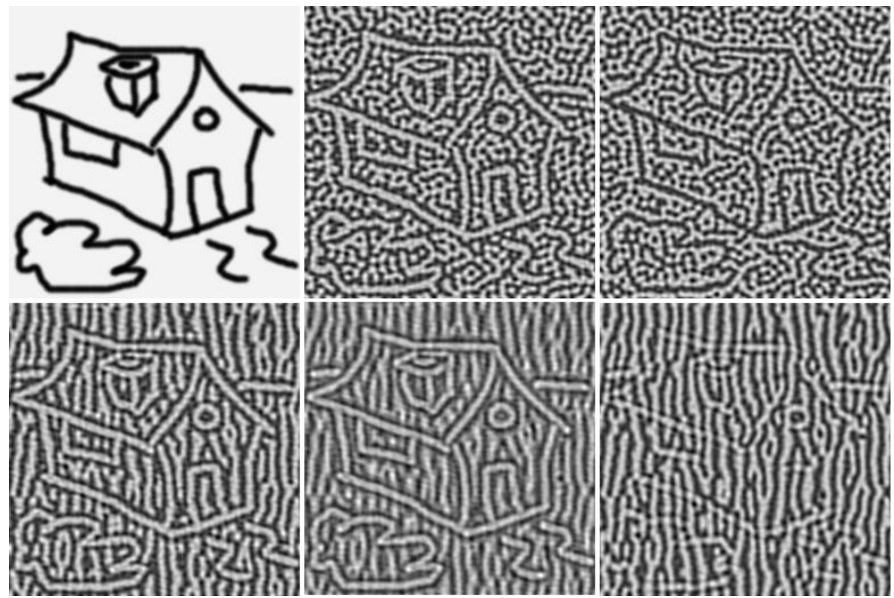
Distortion conserving the histogram : [shadertoy]

Details respect context

conserve something else

- Distortion conserving the histogram : [shadertoy]

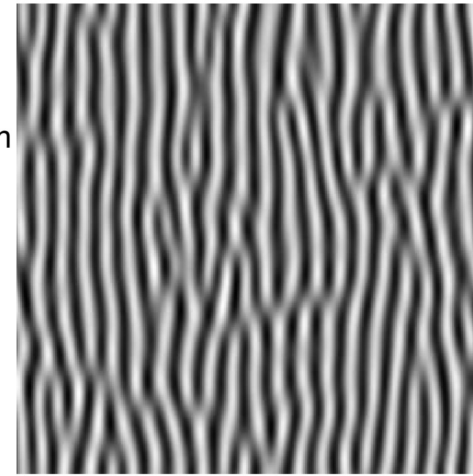
- Influenced procedural: iterated Gabor noise renormalization



Synthesis:

1st, specification: what do we really want ?

E.g. "I want to generate this"



stochastic - wavy - Fourier vs "features" vs specific - ϕ

Fourier synthesis, Gabor, Perlin vs example-based vs RD, sym

None is good for all !

(free range vs) bounded vs target contrast ?

How to normalize Fourier, Perlin ? (but never clamp !)

Histogram ? slopes ? 'profil' of waves ?

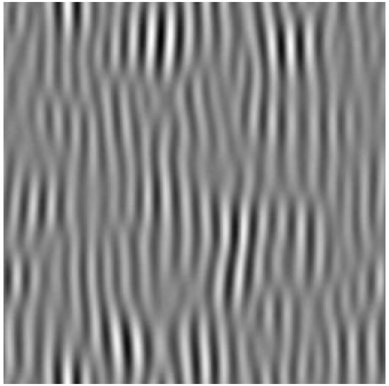
Sparse convolution vs Gabor

Props = globally, or in each sub-window (i.e. uniform) ?

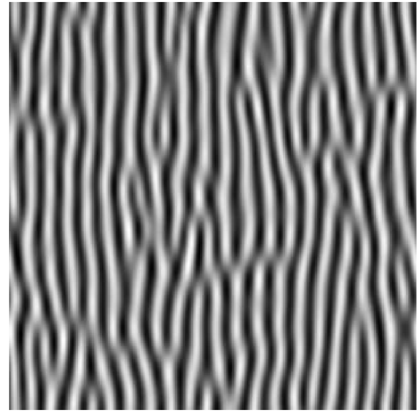
Spectrum prop implies (often) not what you think :-)

Which controls (for constraints, modulation) ?

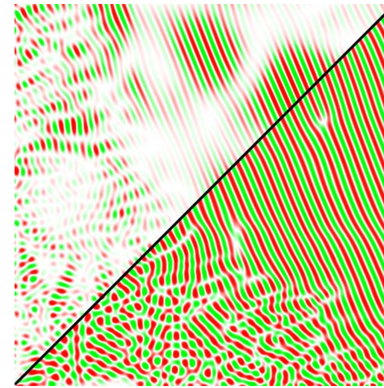
Fourier (including Gabor) always gives this : not this :



(contrast oscillations, Even in no LF)



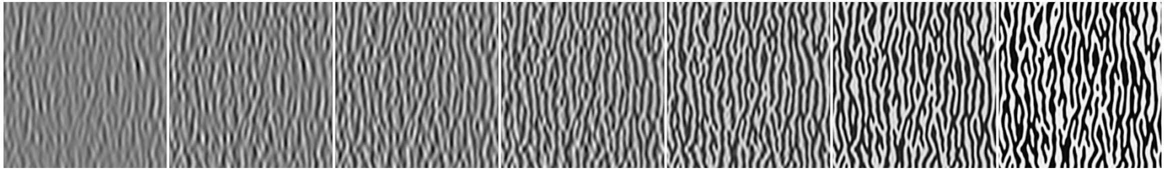
Bad for LUT :

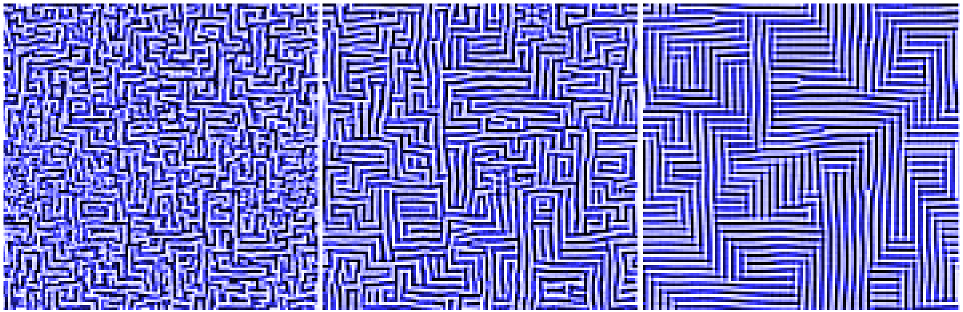


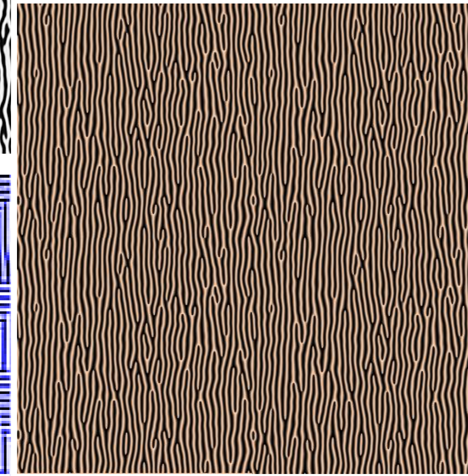
Challenges :

- Make criterions of different worlds talk together / add handles
- Controlling spectrum AND histogram/normalization
- Bridging between the look of different synthesis algorithms
- Understanding what is a texture :-)

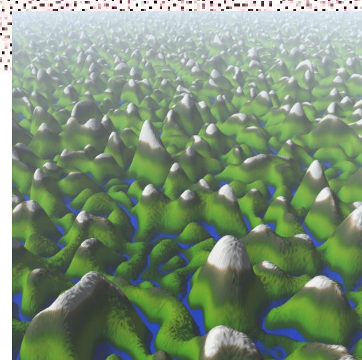
→ my current research work around Gabor / Fourier / variance spectrum

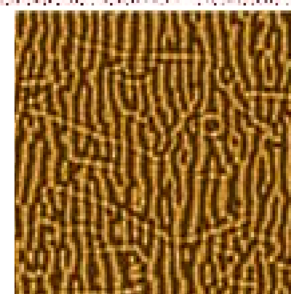






early
results...





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