I Know What's Moved!

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Thanks To

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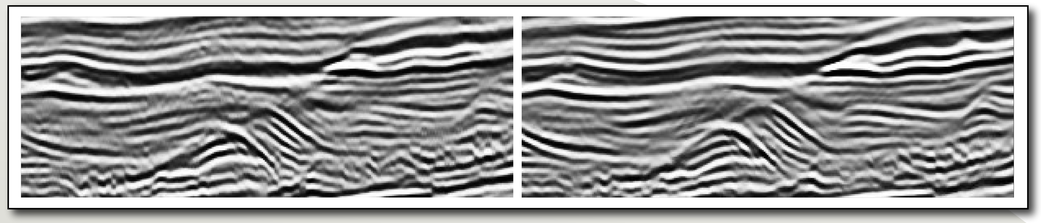
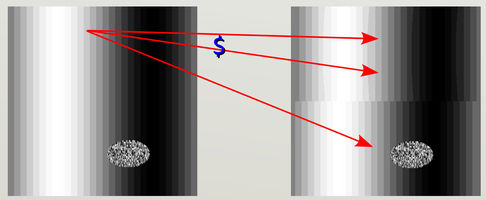
Why Image Registration?

- Oops! Not here. $$$$$ are gone!! See it before drilling: Fluid (Oil) moves but rocks don't
- Medical Imaging? Just pictures until adding a brain: Registration tells how things progress
- Freeze except suspect(s)!: Surveillance Camera
- Everything moves! People want to know what is moving and where it moves!

Show Me Pictures!



Tell me what's moved.
OK... You're good.
Then where has it moved?



Some Mathematics

Earlier Approach (L2 Norm)

$$\text{Minimize eq. } \lambda \iint (\ (x,y,t) - \ (x+\delta u_x, y+\delta u_y, t+\delta t))^2 dx\,dy + \iint \nabla u^2\, dx\,dy$$

- Doesn't allow discontinuities in displacement fields
- Doesn't handle outliers in the data field robustly.
- Numerically easy to solve

Recent Approach (L1 Norm)

$$\text{Minimize eq. } \lambda \iint \ (x,y,t) - \ (x+\delta u_x, y+\delta u_y, t+\delta t)\, dx\,dy + \iint \nabla u\, dx\,dy$$

- More weight to smaller value, less weight to larger value compare to the L2.
- Allow discontinuities.
- Numerically harder

What Math Tells Us?

First integral term: After objects move from one image to another image, intensity (color) difference should be minimized.

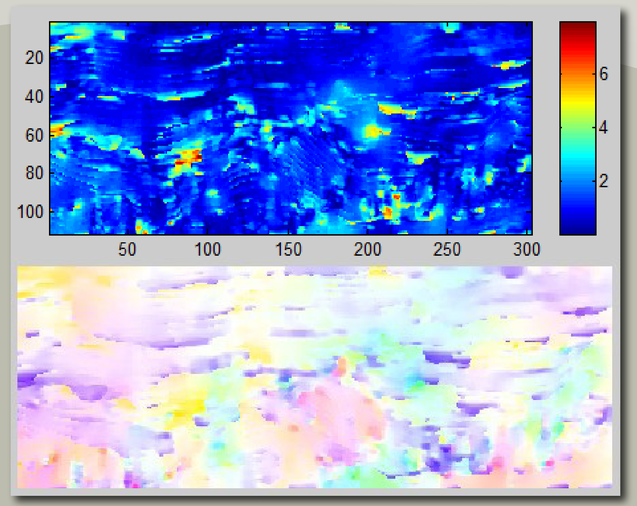
Second integral term: There would be multiple pixels with same intensity difference. We want neighboring pixels move similarly (No abrupt changes).

λ controls how much each term contributes to the minimization process Implementation

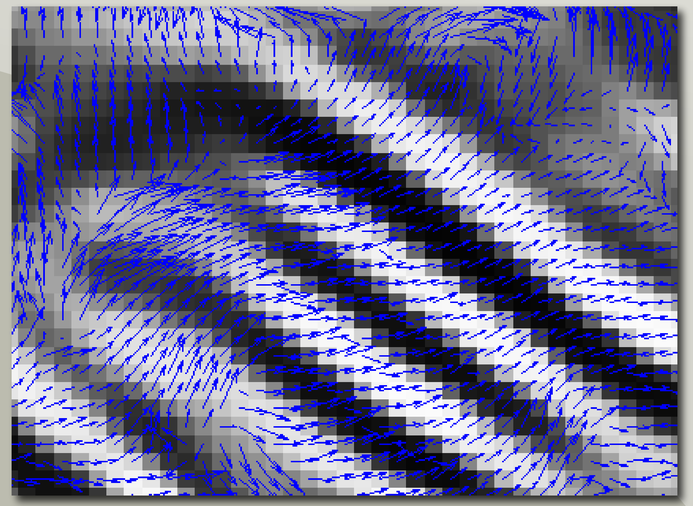
Implementation

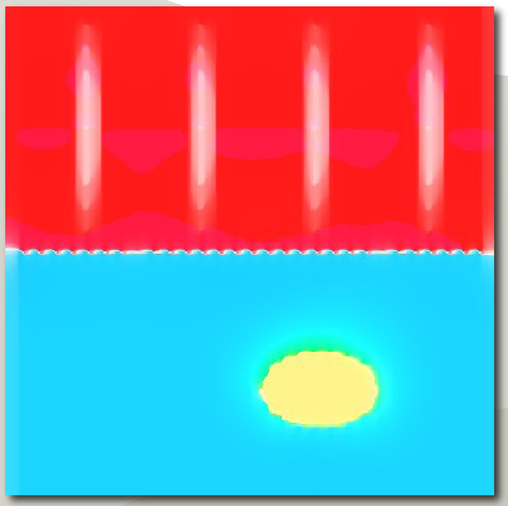
- Multi-level Implementation (Coarse to Fine layer)
- Warping
- Mathematical Minimization

Current Results

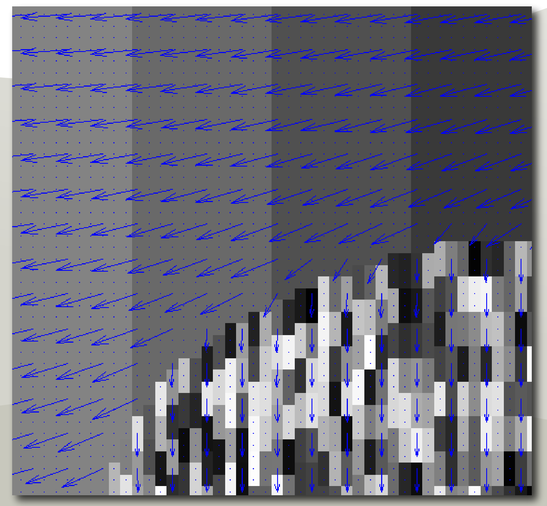


Length / Color Wheel





Representation of Color Wheel



Shown every three other pixels

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