

Reconstrucción 3D y procesamiento de imágenes por métodos de gradiente.

Seminario de Ingeniería Biomedica 2016

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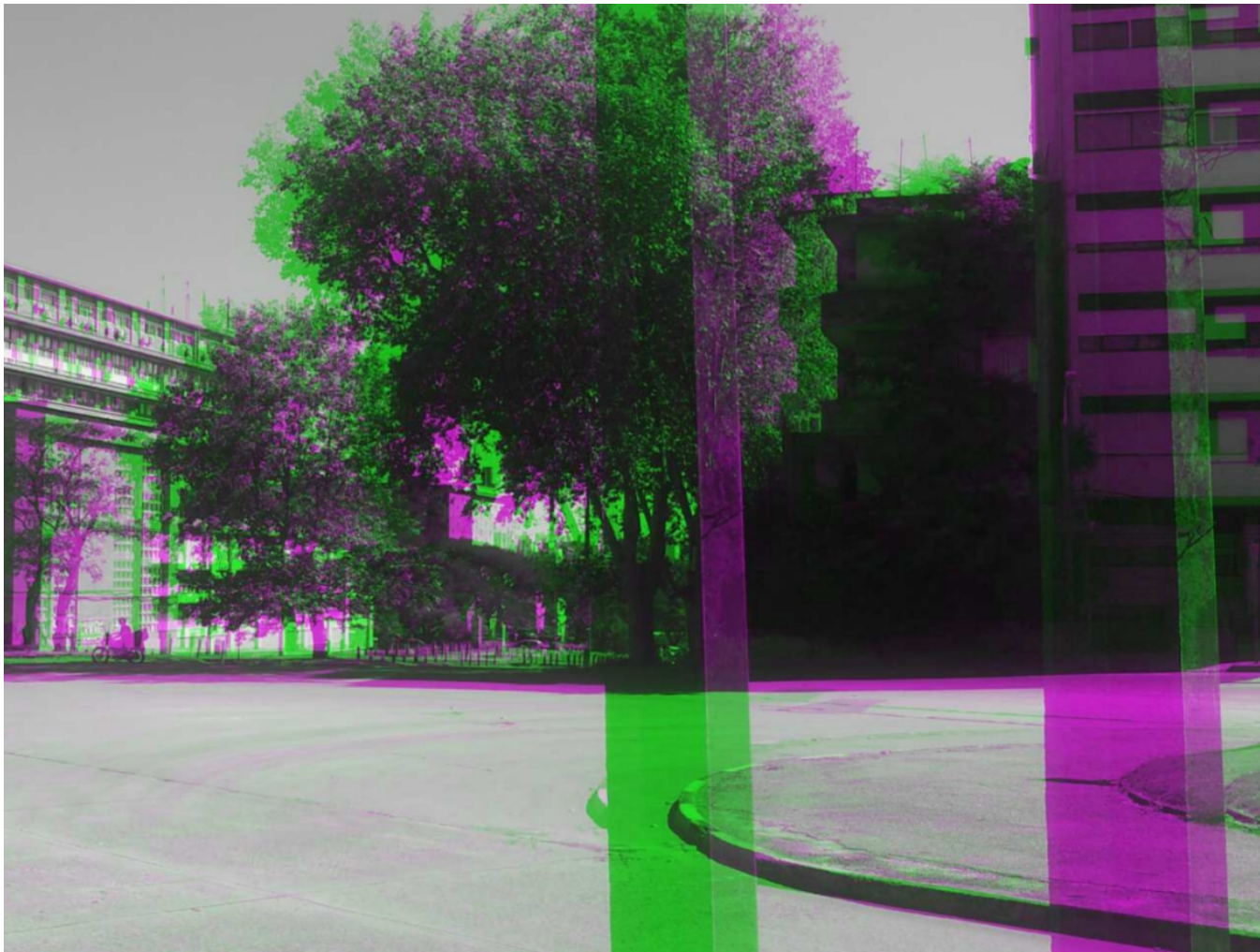
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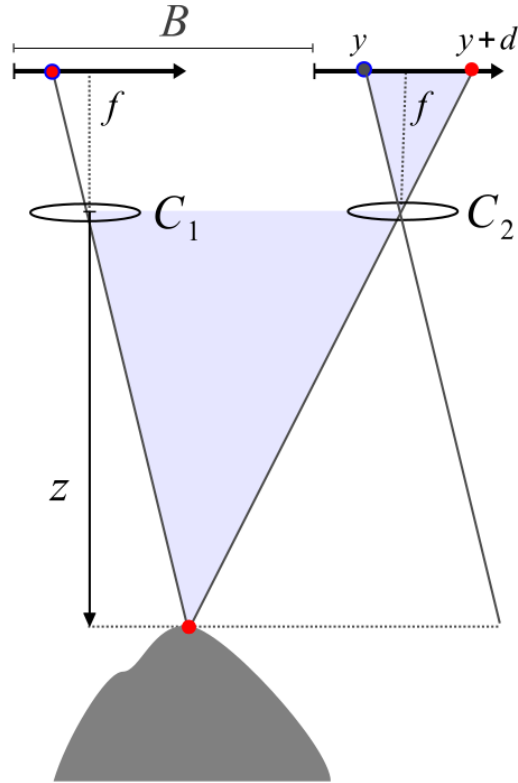
Montevideo, mayo de 2016







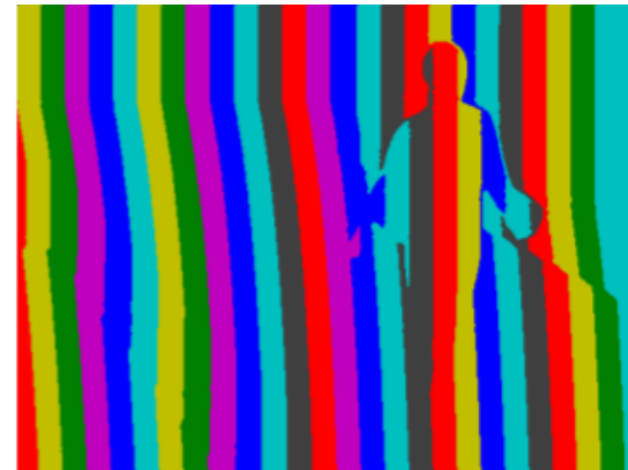
Geometría de visión estero



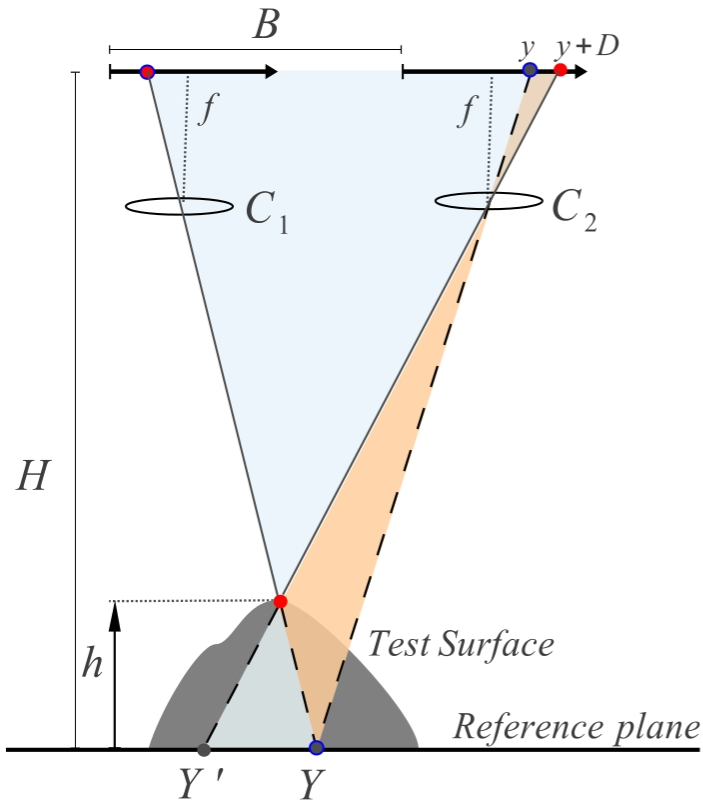
$$z(x, y) = \frac{Bf}{d(x, y)}$$

$$z \leftrightarrow d$$

Estéreo activo



Geometría de visión estero



$$h \approx D \frac{H^2}{B f}$$

$$h \leftrightarrow D$$

Comparación

Passive-stereo



- Solo en áreas ricas en textura.
- Búsqueda de correspondencias.
- En general, la información es dispersa.
- Hardware accesible.
- Se puede aplicar en cualquier escala.

Active-stereo

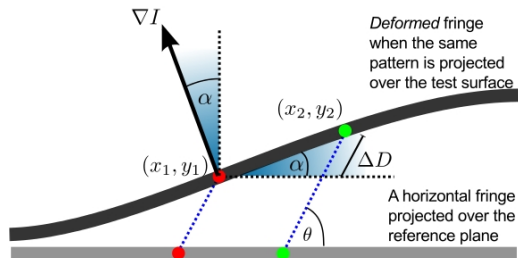
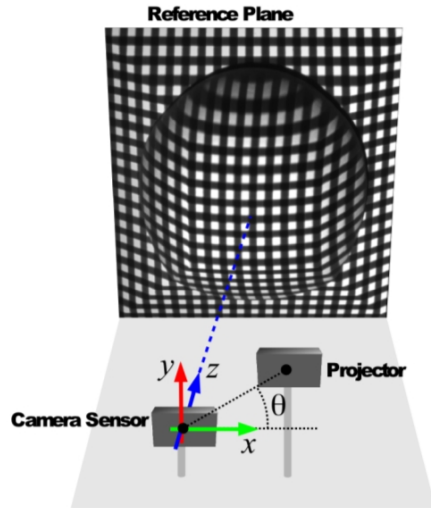


- La iluminación ambiente puede ser un problema.
- No se requiere de escenas texturadas.
- En general, se obtiene información densa.

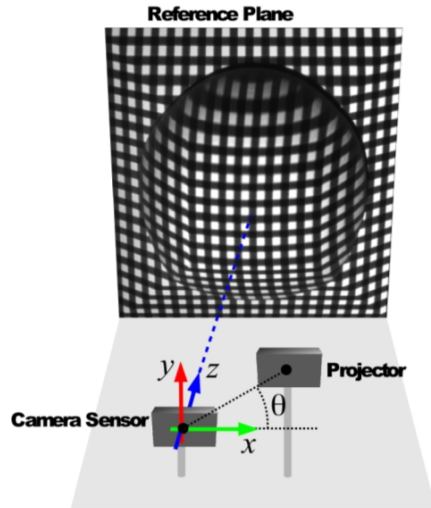
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Técnica basada en gradientes



Técnica basada en gradientes



$$\frac{-I_x}{I_y} = \tan(\alpha) = \frac{(D(x_2, y_2) - D(x_1, y_1)) \sin(\theta)}{x_2 - x_1}$$

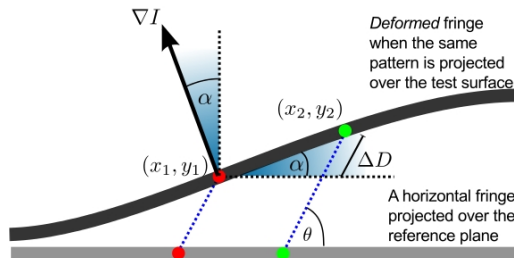
Definiendo $\vec{u} = (x_2 - x_1, y_2 - y_1)$:

$$\frac{-I_x}{I_y} = \frac{D(\vec{x} + \vec{u}) - D(\vec{x})}{|\vec{u}|} \bigg|_{\vec{x}=(x_1, y_1)} \frac{|\vec{u}|}{x_2 - x_1} \sin(\theta)$$

Tomando el límite $|\vec{u}| \rightarrow 0$:

$$\Rightarrow \tan(\alpha) = \frac{I_x}{I_y} = \frac{-D_x \sin(\theta)}{1 - D_y \sin(\theta)}$$

$$\nabla I \leftrightarrow \nabla D$$



Como integramos ese campo?

Notación:

$Z : \Omega \subset \mathbb{R}^2 \rightarrow \mathbb{R}$ es la superficie obtenida si *integramos* el campo $(p, q) : \Omega \rightarrow \mathbb{R}^2$.

$$p \approx Z_x, \quad q \approx Z_y, \quad \nabla \times (p, q) \neq 0$$

Least Squares (LS)

$$E[u] = \int \int (|u_x - p|^2 + |u_y - q|^2) dx dy$$

Ecuaciones de Euler-Lagrange:

$$\begin{cases} \nabla^2 u = \operatorname{div}(p, q) \\ (u_x - p)\nu_1 = 0 \text{ on } \partial\Omega \\ (u_y - q)\nu_2 = 0 \text{ on } \partial\Omega \end{cases}$$

- No es robusto cuando hay ruido o errores no lineales.
- Se resuelve de manera muy eficiente y rápida (FFT).









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Poisson Image Editing

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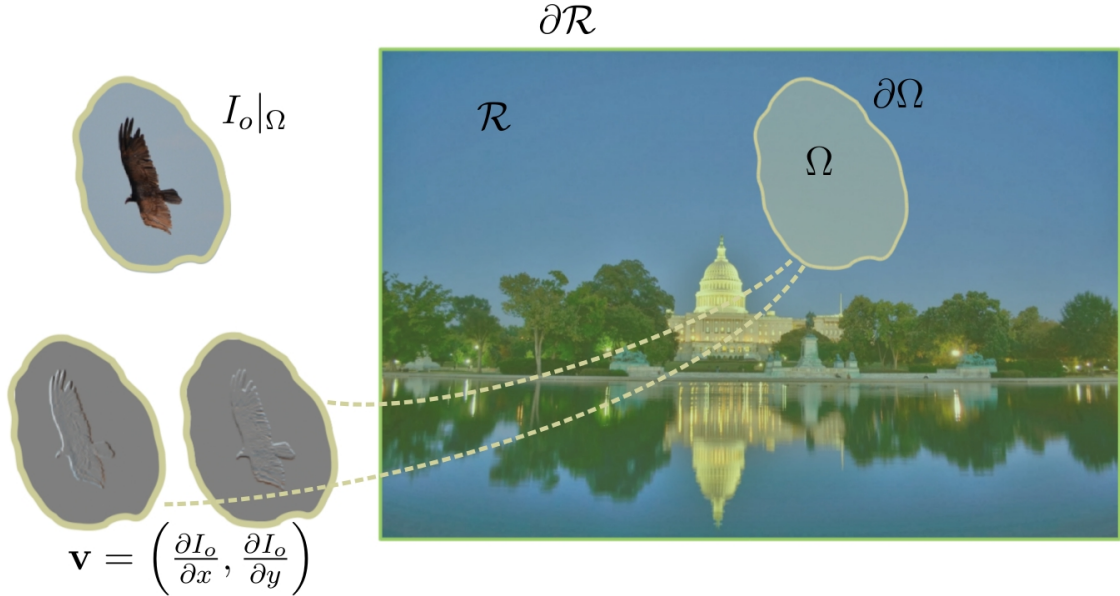
Poisson Image Editing

$$\min_{f \in \mathcal{C}^2(\mathcal{R})} \int_{\Omega} \|\nabla f - \mathbf{v}\|^2 dx$$

st. $f|_{\mathcal{R} \setminus \Omega} = f^*|_{\mathcal{R} \setminus \Omega}$

$$\Delta f(x) = \operatorname{div}(\mathbf{v}(x))$$

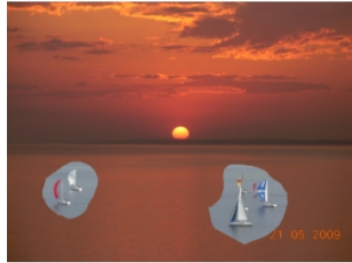
for all $x \in \Omega$, and $f|_{\partial\Omega} = f^*|_{\partial\Omega}$



Input



Copy-paste



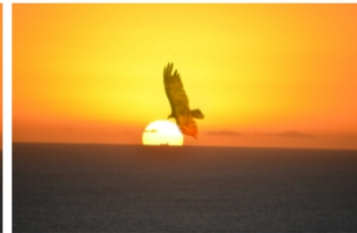
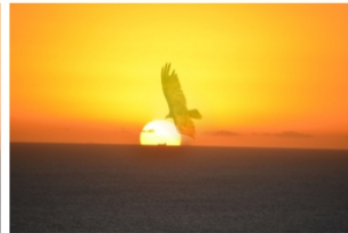
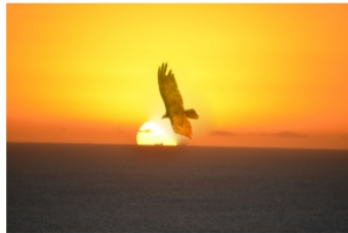
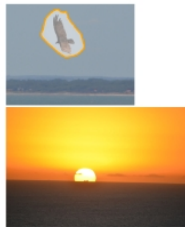
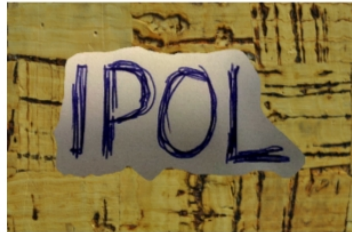
Replace



Average



Maximum



Input image



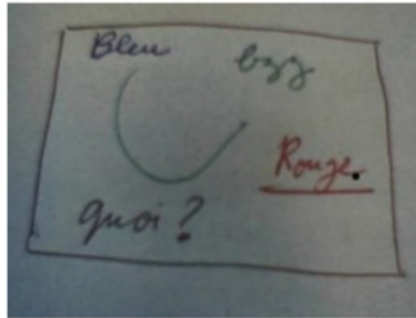
$T = 20$ and $\alpha = 2,5$



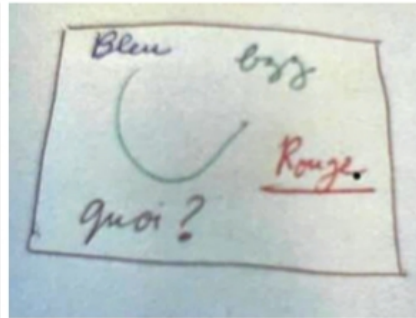
Ω



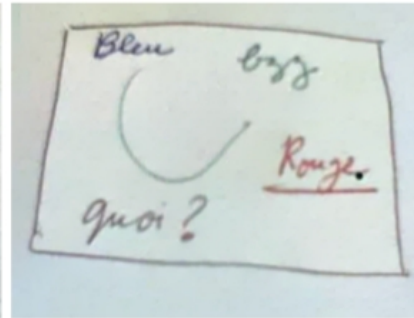
Input image



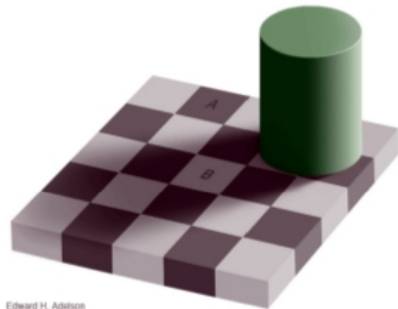
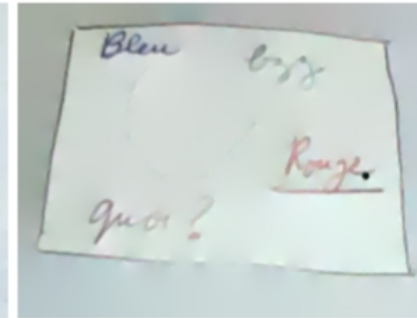
$T = 2$



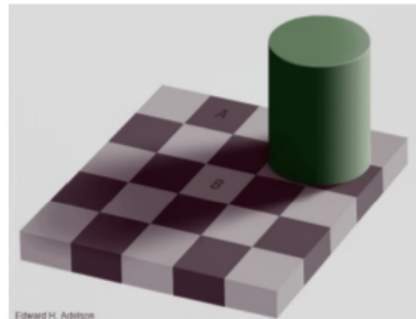
$T = 5$



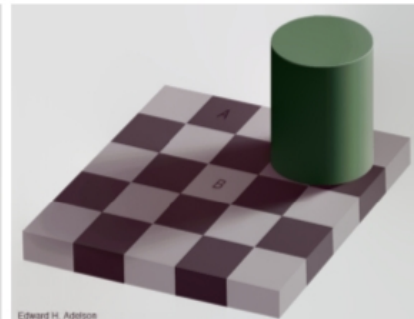
$T = 15$



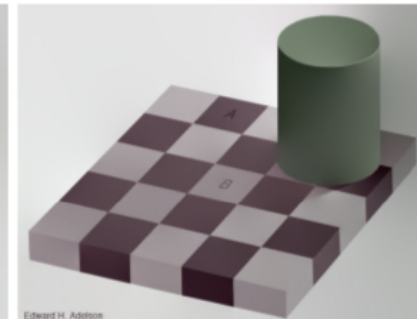
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