Spatial Patch Blending Algorithm for Artefact Reduction in Patch-based Inpainting Methods.

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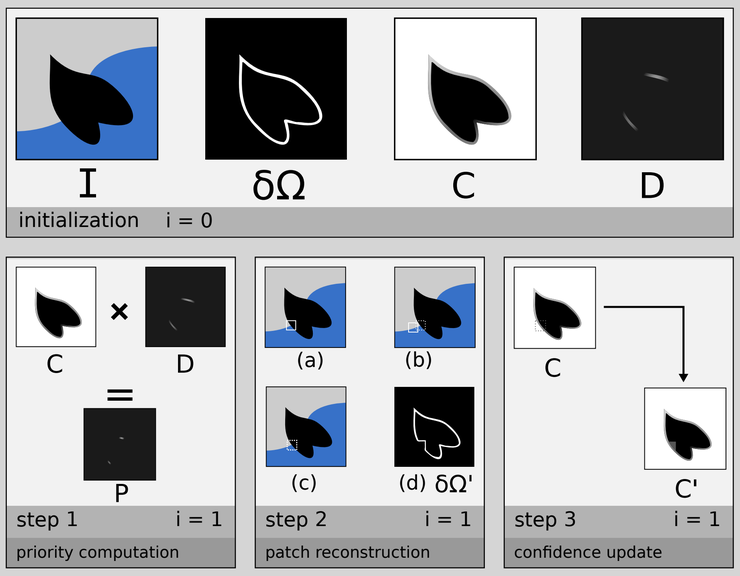
Patch-based inpainting: entry-level algorithm



Problems and solution

Problems

- Always pathological cases of reconstruction artefacts (cf. Fig. 1(b))
- Appearance of seams between reconstruction patches

Solution

1. Artefact detection ⇒ locations of locally bad reconstructions

2. Spatial patch blending ⇒ reconstruction patches seams reduction

1. Artefact detection

a. Reconstruction artefact locations ?

i) Existence of sharp variations in I ⇒ high $\|\nabla I\|$

ii) Reconstruction patch locations $\mathcal{U}$ locally very different ⇒ high $div(\mathcal{U})$

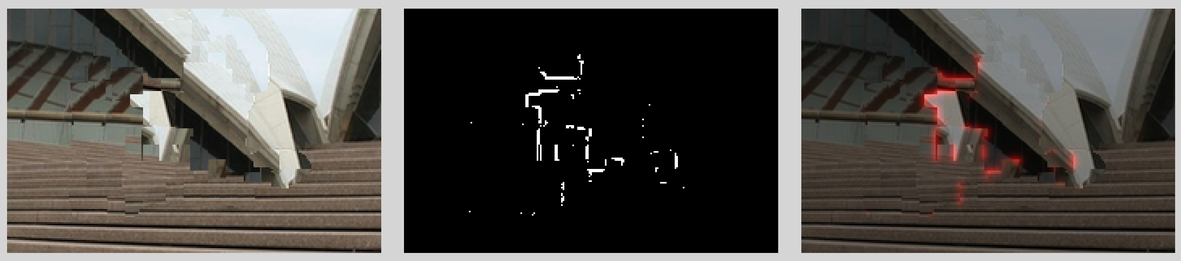
b. Break field $\mathcal{R}(p)$: strength of artefacts, combination of hypothesis *i*) and *ii*)

$$\forall p \in \Omega, \quad \mathcal{R}(p) = \frac{\|\nabla I(p)\| \cdot |\ \mathrm{div}(\mathcal{U})(p)\ |}{\alpha}$$

where α is a normalization factor.

c. Blending amplitude map

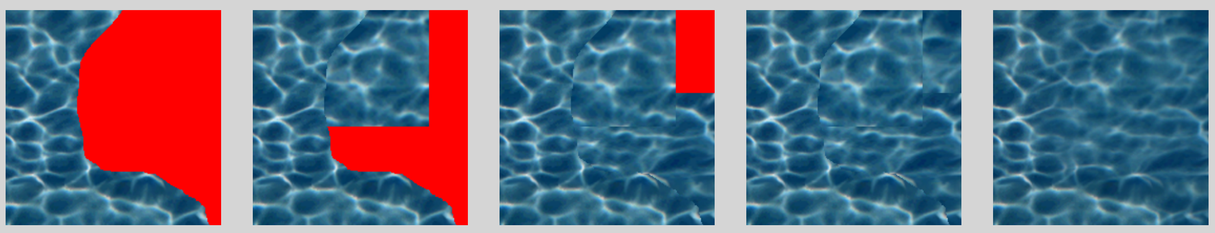
$$\forall p \in \Gamma, \quad \sigma(p) = \rho \times \frac{\sum_{r \in \mathcal{E}} w_b(p,r)}{\max_{q \in \Gamma} \sum_{r \in \mathcal{E}} w_b(q,r)} \quad \text{with } w_b(p,q) \text{ a Gaussian function}$$



(a) Patch-based inpainting result. (b) Detected *break points*. (c) Detected artefacts areas.

2. Spatial Patch Blending

- Principle: remove seams between reconstruction patches



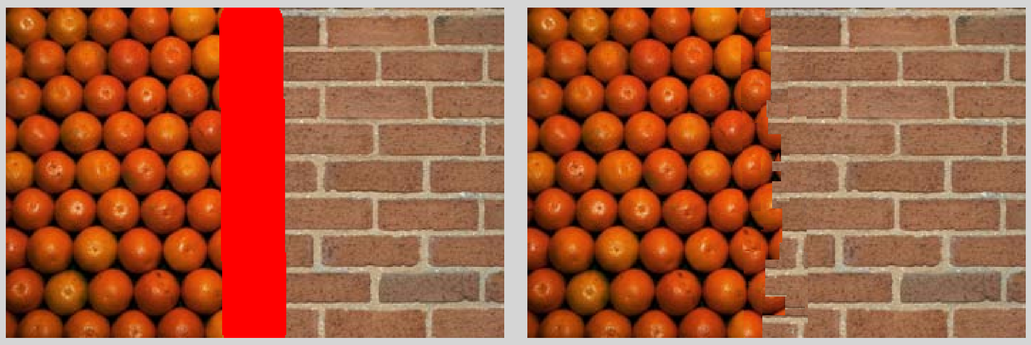
(d) Masked image. (e) One patch later. (f) Three patches later. (g) Inpainting result. (h) blending result.

- Equation: compose an image J with a set Ψ_p of reconstruction patches ψ_q centered at each q, from a neighbourhood of p

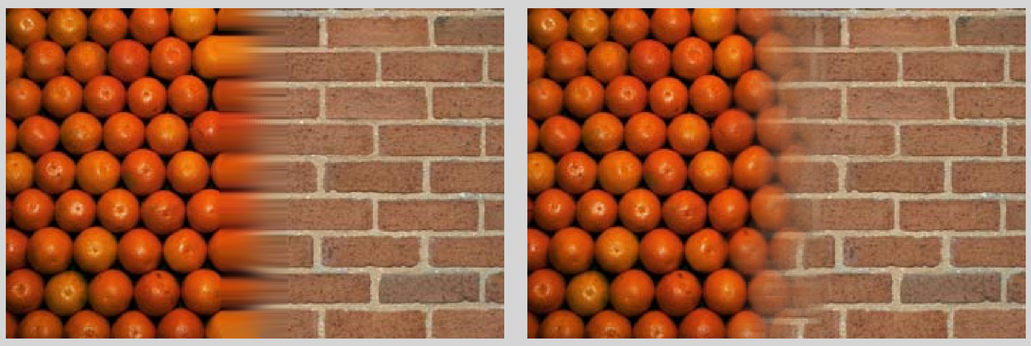
$$J^i(p) = \frac{\sum_{\psi_q \in \Psi_p} w(q,p)\ \psi_q^i(p-q)}{\varepsilon + \sum_{\psi_q \in \Psi_p} w(q,p)}$$

with $w(q,p)$ a gaussain weight based on a distance from q to p.

Comparison with a synthetic case



(a) Masked color image. (b) Criminisi inpainting result.



(c) Diffusion PDE inpainting result. (d) Criminisi + our spatial patch blending result.

Results and comparison with state-of-the-art methods

Our method is already embedded inside a **G'MIC** plugin for **GIMP**:
http://gmic.sourceforge.net/gimp.shtml