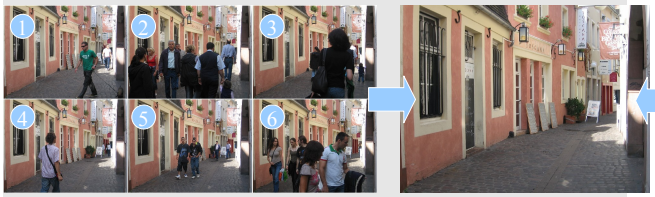
Background estimation from photographs

Miguel Granados[1], Hans-Peter Seidel[1], Hendrik P.A. Lensch[2]
[1]Max Planck Institut für Informatik, [2]Universität Ülm

Problem

To compute the *scene background* from a set of photographs featuring several occluders.
We assume (a) static background, (b) constant illumination, and (c) constant camera settings.



Strategy

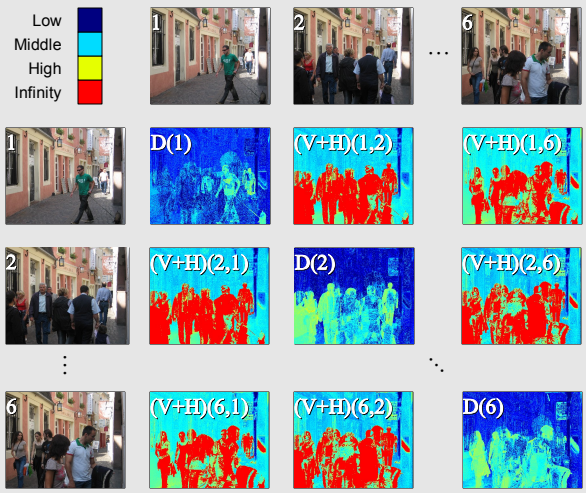
We construct the background by selecting a source image for each pixel, while taking care that no inconsistencies are created. We select the image sources by assigning costs according to how well they model the background[1]. The resulting cost function is minimized using the *expansion-move* algorithm[3], whose main optimization step is performed via *graph-cuts*[4].

Cost function

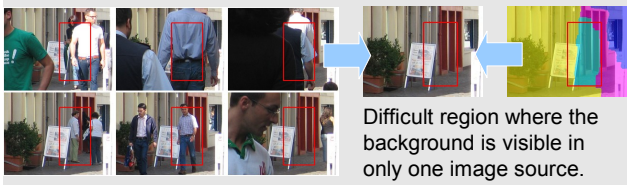
We minimize an energy functional of the form:

$$E(f) := \sum_{p \in P} \mathrm{D}_p(f(p)) + \sum_{(p,q) \in N} \left[\mathrm{V}_{p,q}(f(p), f(q)) + \mathrm{H}_{p,q}(f(p), f(q)) \right]$$

D	Data term	Penalizes *unlikely image sources*, both in the intensity and gradient domain.
V	Smoothness term	Penalizes *inconsistent transitions* between image sources.
H	Consistency constraint	Excludes *unobserved transitions* from the the solution space.

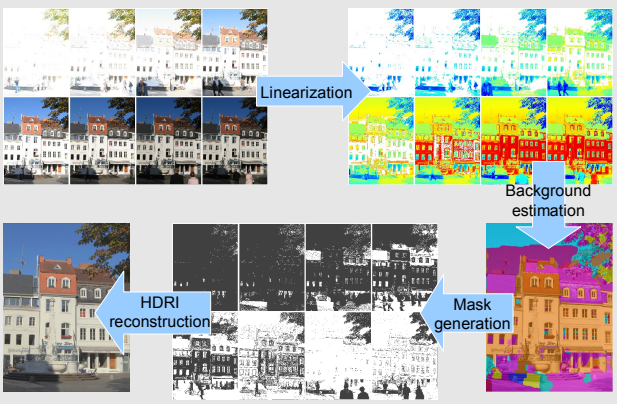


Results



Difficult region where the background is visible in only one image source.

Deghosting in HDR imaging



We adapt our method in order to handle image sequences with varying exposure time. First, we linearize the input images, and then estimate the background in the irradiance domain. We use the estimation to generate background masks and compute a *deghosted*[4] high dynamic range image.

Consistency constraint

We exploit the fact that the input photographs are already consistent, and avoid unobserved transitions by assigning them an infinite cost[4].

Unconstrained Constrained

References

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max planck institut informatik