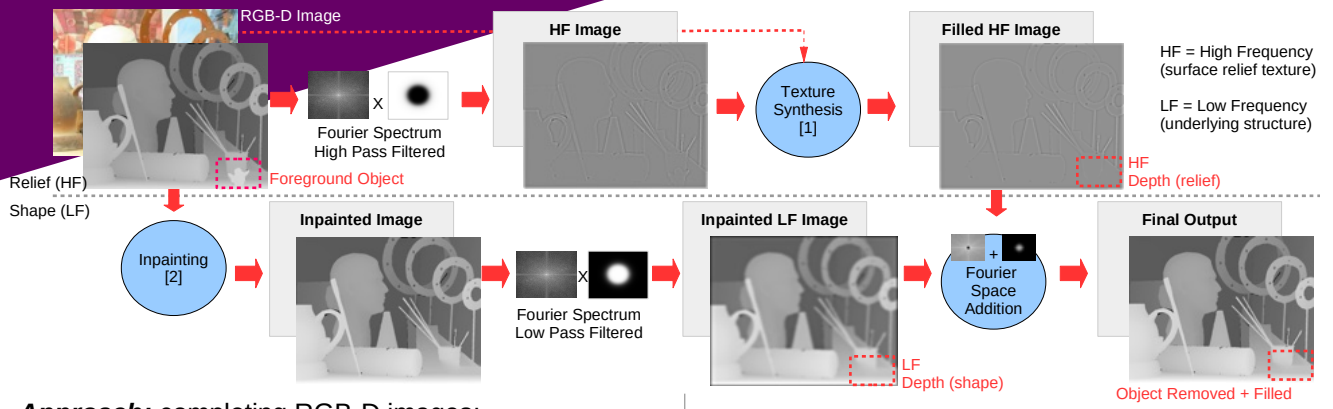# Back to Butterworth - a Fourier Basis for 3D Surface Relief Hole Filling within RGB-D Imagery

Amir Atapour Abarghouei,
Gregoire Payen de La Garanderie, Toby P. Breckon
Durham University, UK

Issue: object removal and plausible hole filling in RGB-D images with surface relief detail

Approach: completing RGB-D images:

*(1) **Separation** of depth image via **Fourier Transform**: high spatial frequency image **(edges and surface relief),** and low spatial frequency image **(continuous surface shape & depth gradients).***

*(2) Fill holes in the high frequency image via an **extended synthesis** method based on [1].*
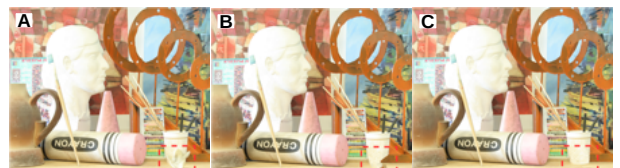
Classical texture synthesis [1] is improved by query expansion in the search space (color image completion). Original object marked in (A) is removed using [1] (B) and also by our extended method (C).

*(3) Use **inpainting** [2] to propagate the underlying shape structures in the low frequency image.*

*(4) Final **recombination** of the low frequency shape image obtained from structural inpainting and the high frequency image from the extended texture synthesis in **Fourier space**.*
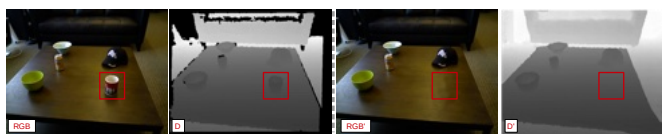
Removing objects from RGB-D images.

Results: accurate object boundaries, without artefacts or blurring, with plausible underlying geometry.
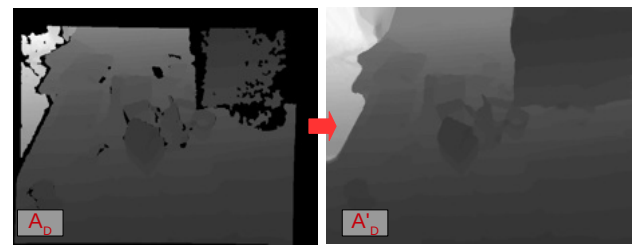
Filling depth map holes occurring due to the limitations of the current depth estimation technology.

Applied to automotive stereo disparity maps to remove dynamic scene objects (vehicles, pedestrians) - original (left), filled (right).

[1] A. A. Efros and T. K. Leung, "Texture synthesis by non-parametric sampling," in Proc. Int. Conf. Computer Vision, vol. 2. IEEE, 1999, pp. 1033–1038.
[2] P. Arias, G. Facciolo, V. Caselles, and G. Sapiro, "A variational framework for exemplar-based image inpainting," Int. J. computer vision, vol. 93, no. 3, pp. 319–347, 2011.