Variational Multi-Image Stereo Matching

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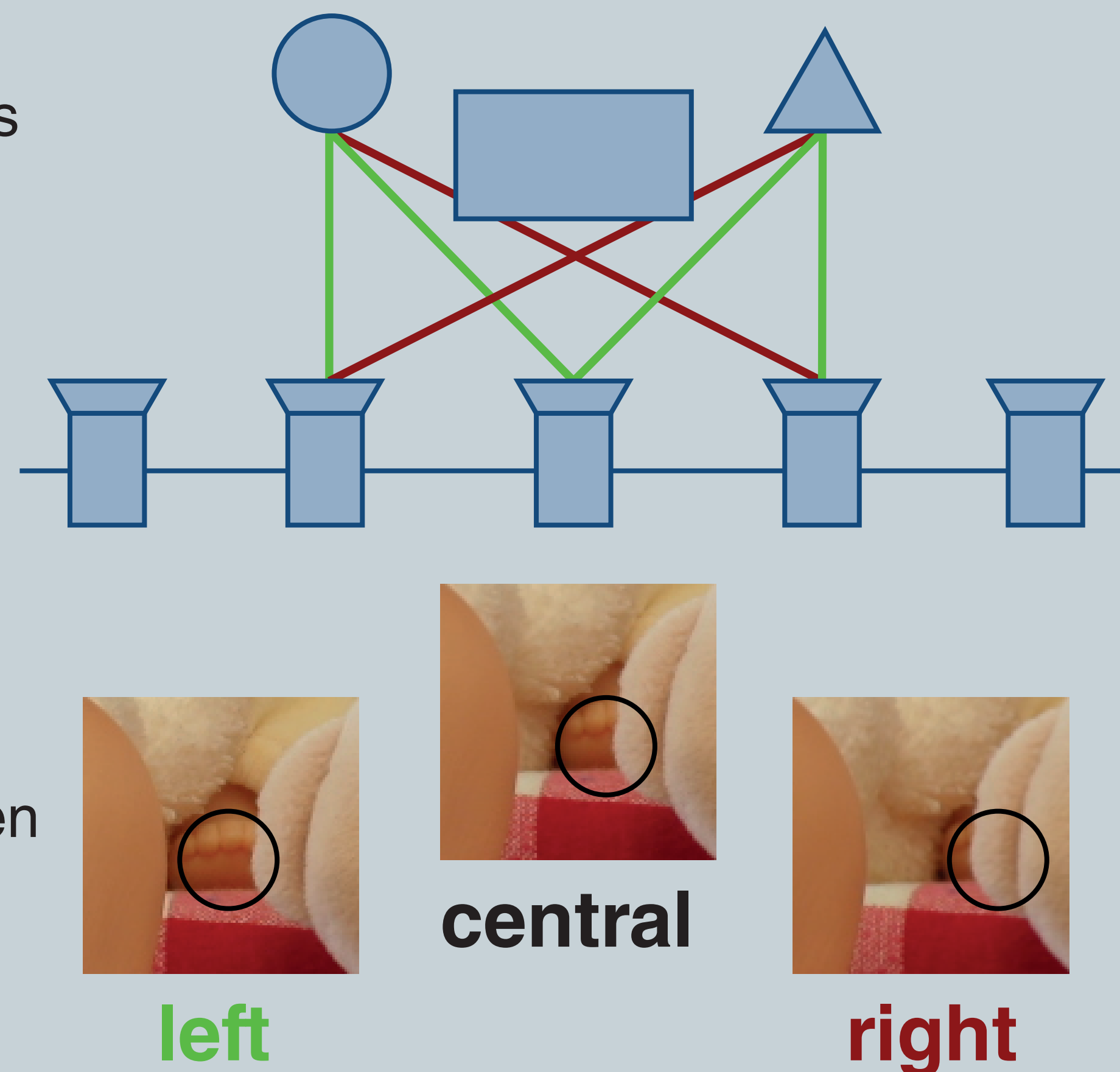
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PROBLEM STATEMENT

Two-view stereo estimates a **dense depth map** for images using two views of a single scene.

The depth of a pixel is a function of its horizontal shift between both images: the **disparity**.

When only two views are available, **occlusions** form a big issue: near boundaries, background pixels are often **invisible in many views**. Methods should take this into account for more accurate disparity estimation.
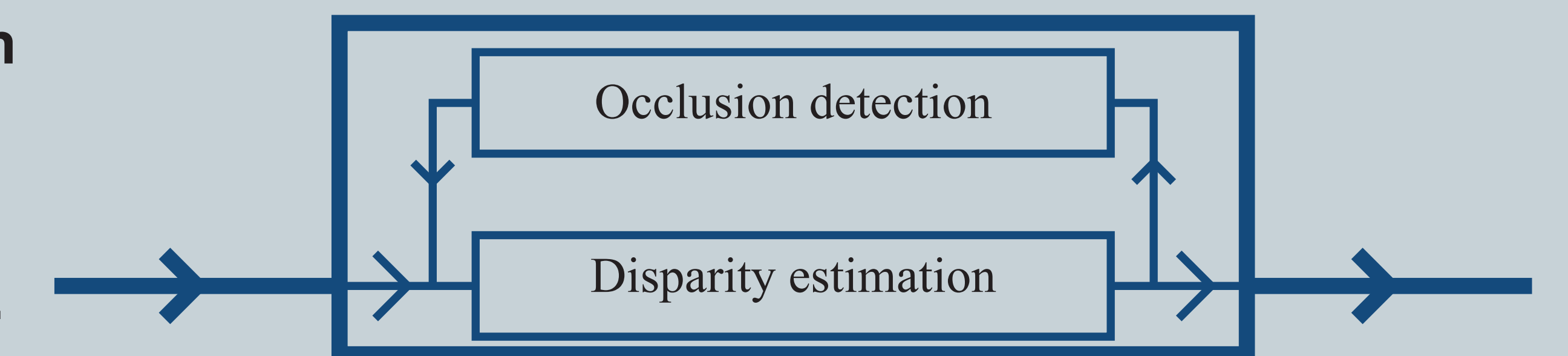
left   central   right

PROPOSED APPROACH

In the **iterative optimisation**, we alternate between an update step for the disparity estimation and the **detection of occlusion** based on the current **depth hypothesis**.

The disparity estimation is regularised through a **total variation** scheme, steered by a **bilateral filter** to preserve edges, explicitly limiting the optimisation of each pixel to views that can observe it.

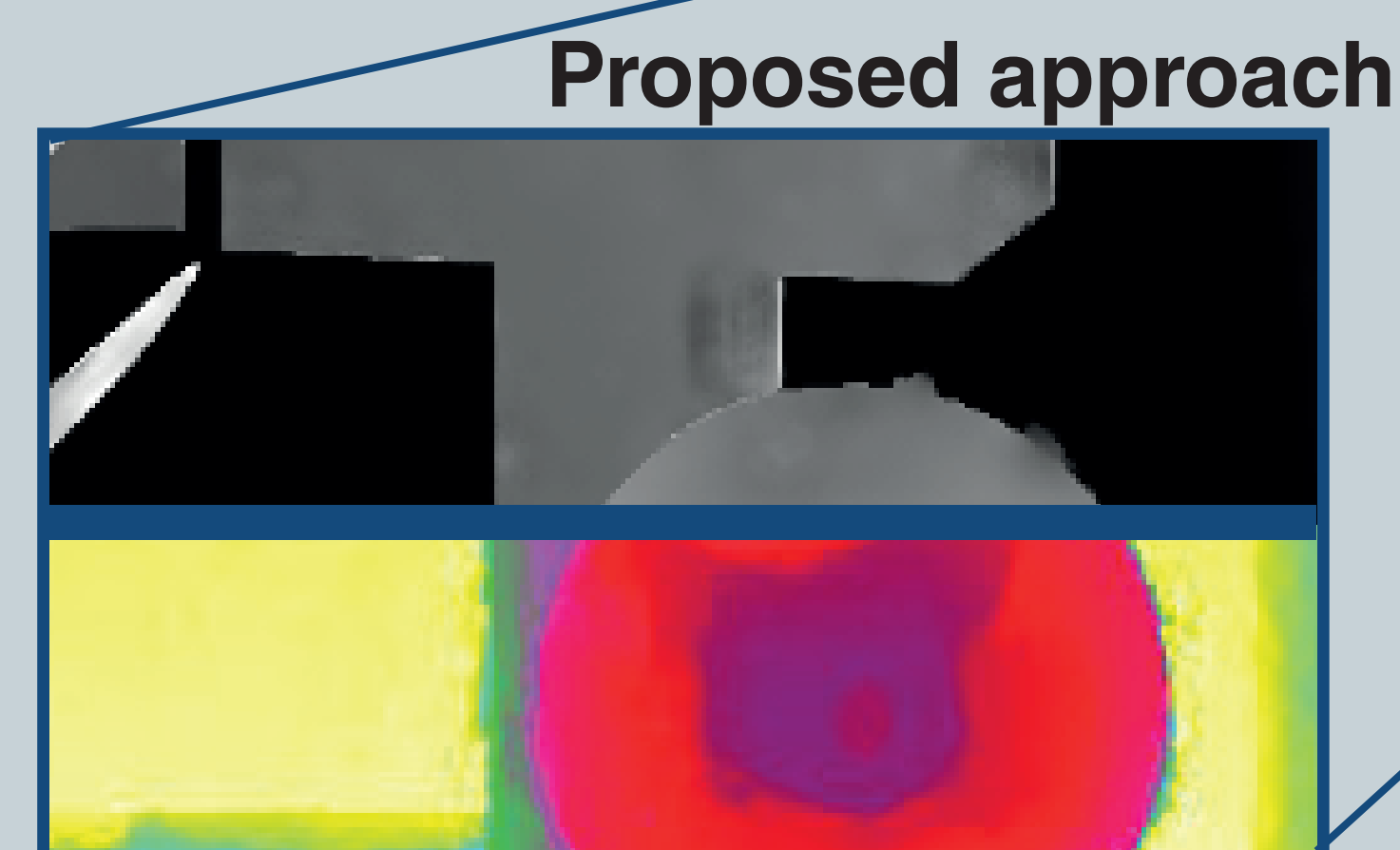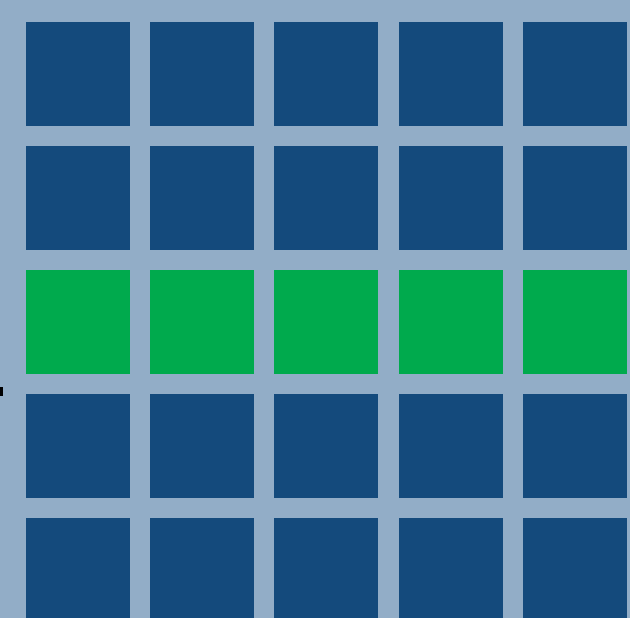Occlusion detection

Disparity estimation

APPLICATIONS AND RESULTS

Disparity and depth estimation from **plenoptic cameras**: a single lens but multiple sensors in a regular grid means a grid of **simultaneous vantage points**.
Plenoptic cameras can capture **dynamic scenes**, but often have **limited resolution**.

Plenoptic cameras capture a 2D array of views, but the displayed results only used the central row of views
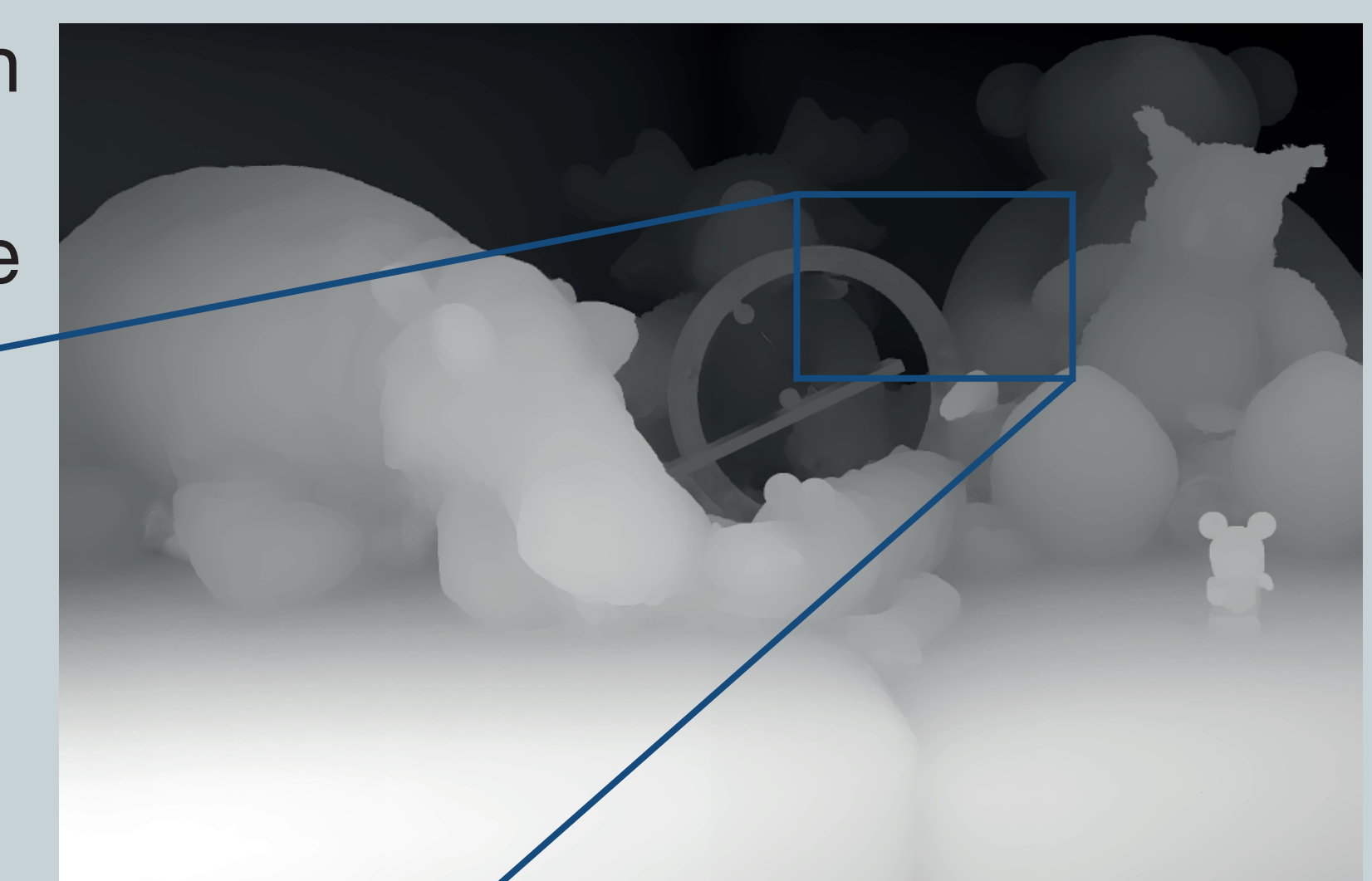
The extension to a 2D grid of views is immediate.

Proposed approach

"Variational Light Field Analysis for Disparity Estimation and Super-Resolution", Wanner et al. PAMI '14

A camera moving along a **camera dolly** or over a track results in a series of vantage points along a linear line.
This is limited to **static scenes** because sampling is also done through time, but allows the use of a **standard camera**.

Proposed approach

"Scene Reconstruction from High Spatio-Angular Resolution Light Fields", Kim et al. SIGGRAPH '13

Simon Donné is a PhD student affiliated with the TELIN department at Ghent University, at the research group "Image Processing and Interpretation" (IPI). His research focuses on multi-view camera algorithms, specifically on depth estimation and scene reconstruction.

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