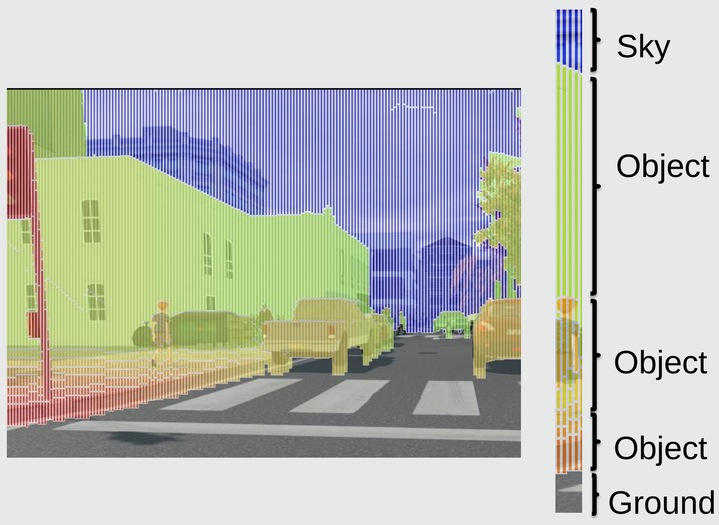
Slanted Stixels: Representing San Francisco's Steepest Streets

Daniel Hernández-Juárez[1†*], Lukas Schneider[3*],
Antonio Espinosa[1], David Vázquez[1,2], Antonio M. López[1,2],
Uwe Franke[3], Marc Pollefeys[4] and Juan C. Moure[1]

[1]Universitat Autònoma de Barcelona [2]Computer Vision Center
[3]Daimler AG [4]ETH Zürich *Contributed equally †Internship at Daimler AG

BMVC 2017 LONDON

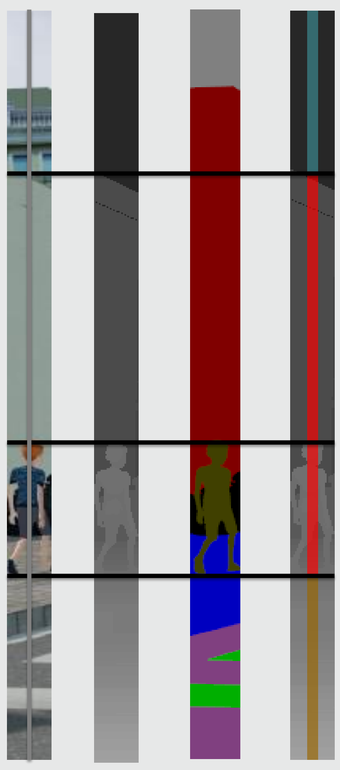
1. Stixel World: Overview



Highlights

- **Goal: Compact representation (vs depth and semantics)**
- **High computational complexity O(w × h²)**
- **Fixed width, variable number per column**

2. Stixel World: Original Model

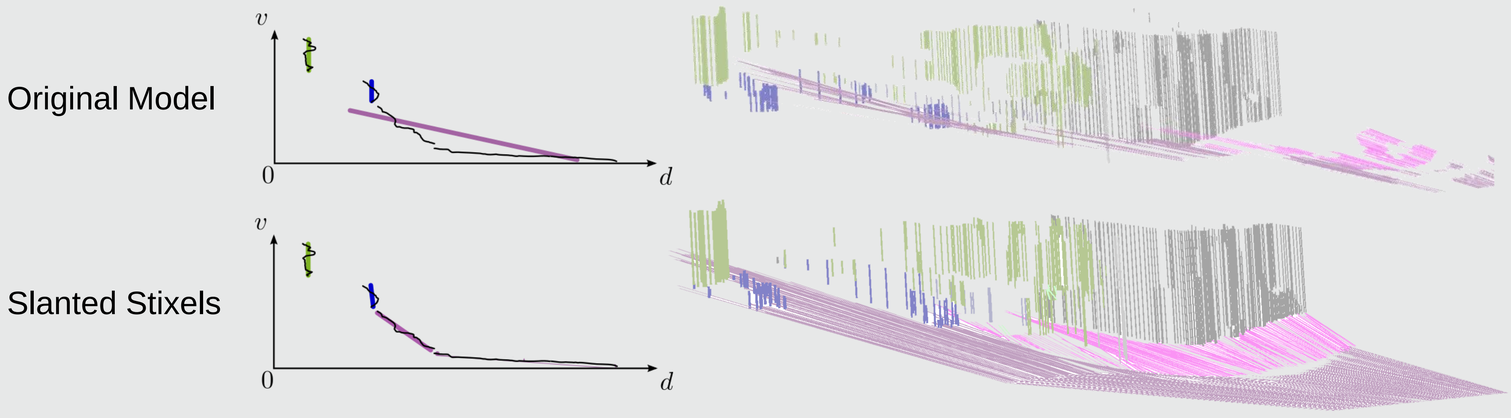


Highlights

- **Unified probabilistic approach**
- **Enforces physical constraints**
- **Computed independently per column**

	Model	Assumption
Sky:	0 disparity	Far away
Object:	Disparity mean	Constant disparity
Ground:	Precomp. Model	Constant height

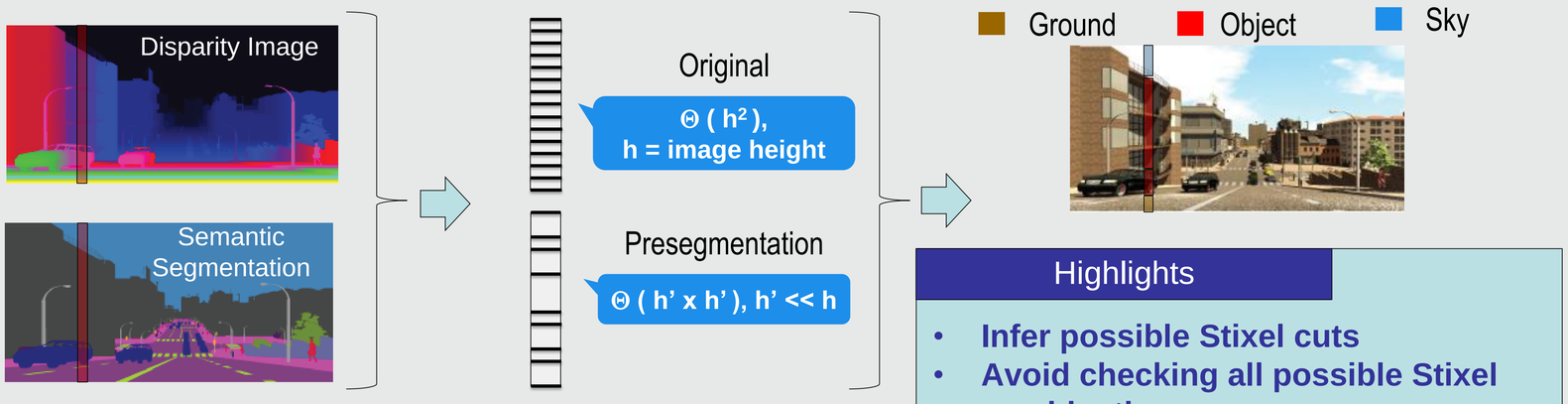
3. New model: Slanted Stixels



Highlights

- **New model to represent all classes:** $\mu(s_i, v) = b_i * v + a_i$
- **With priors depending on the class:** $E_{plane}(s_i) = (\frac{a-\mu^a_{c_i}}{\sigma^a_{c_i}})^2 + (\frac{b-\mu^b_{c_i}}{\sigma^b_{c_i}})^2 - \log(Z)$
- **Each class has different parameters: slanted ground and object and 0 for sky**

4. Presegmentation: Speeding up Stixels computation



Highlights

- **Infer possible Stixel cuts**
- **Avoid checking all possible Stixel combinations**

5. Slanted Stixels: Results

				Presegmentation	
Metric	**Dataset**	**Original**	**Ours**	**Original**	**Ours**
Disp Err (%)	Ladicky	17.3	16.9	18.5	17.8
	KITTI 15	10.9	11.0	11.8	11.7
	SYNTHIA-SF	30.9	**12.9**	33.9	**15.4**
IoU (%)	Ladicky	63.5	63.4	63.9	63.7
	Cityscapes	65.7	65.8	65.7	65.8
	SYNTHIA-SF	46.0	**48.5**	46.9	**48.5**
Frame-rate (Hz)	KITTI 15	113	61	120	116
	Cityscapes	20.9	6.6	36.6	27.5
	SYNTHIA-SF	19.4	4.7	38.9	33.1

Highlights

- **Our method improves for SYNTHIA-SF and maintains accuracy for others**
- **Presegmentation speeds up while keeping similar accuracy**

Acknowledgements
This research has been supported by the MICINN under contract number TIN2014-53234-C2-1-R. By the MEC under contract number TRA2014-57088-C2-1-R and the Generalitat de Catalunya projects 2014-SGR-1506 and 2014-SGR-1562, we also thank CERCA Programme / Generalitat de Catalunya, NVIDIA for the donation of the systems used in this work and SEBAP for the internship funding program. Finally, we thank Francisco Molero, Marc García, and the SYNTHIA team for the dataset generation.