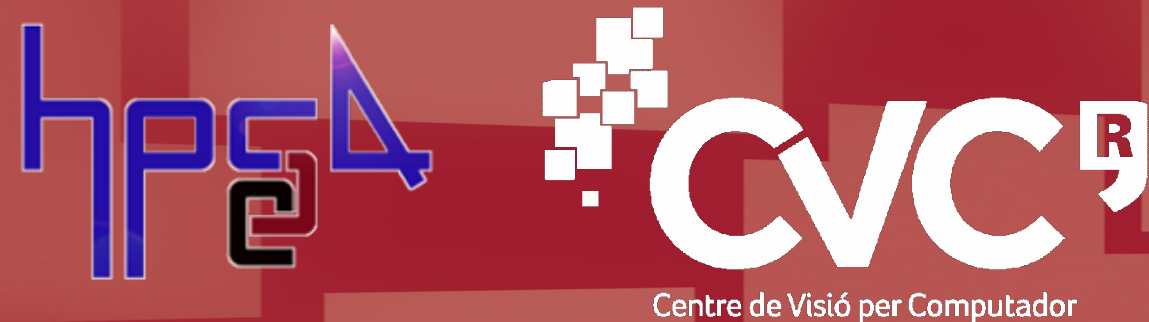


Embedded Real-time Stixel Computation

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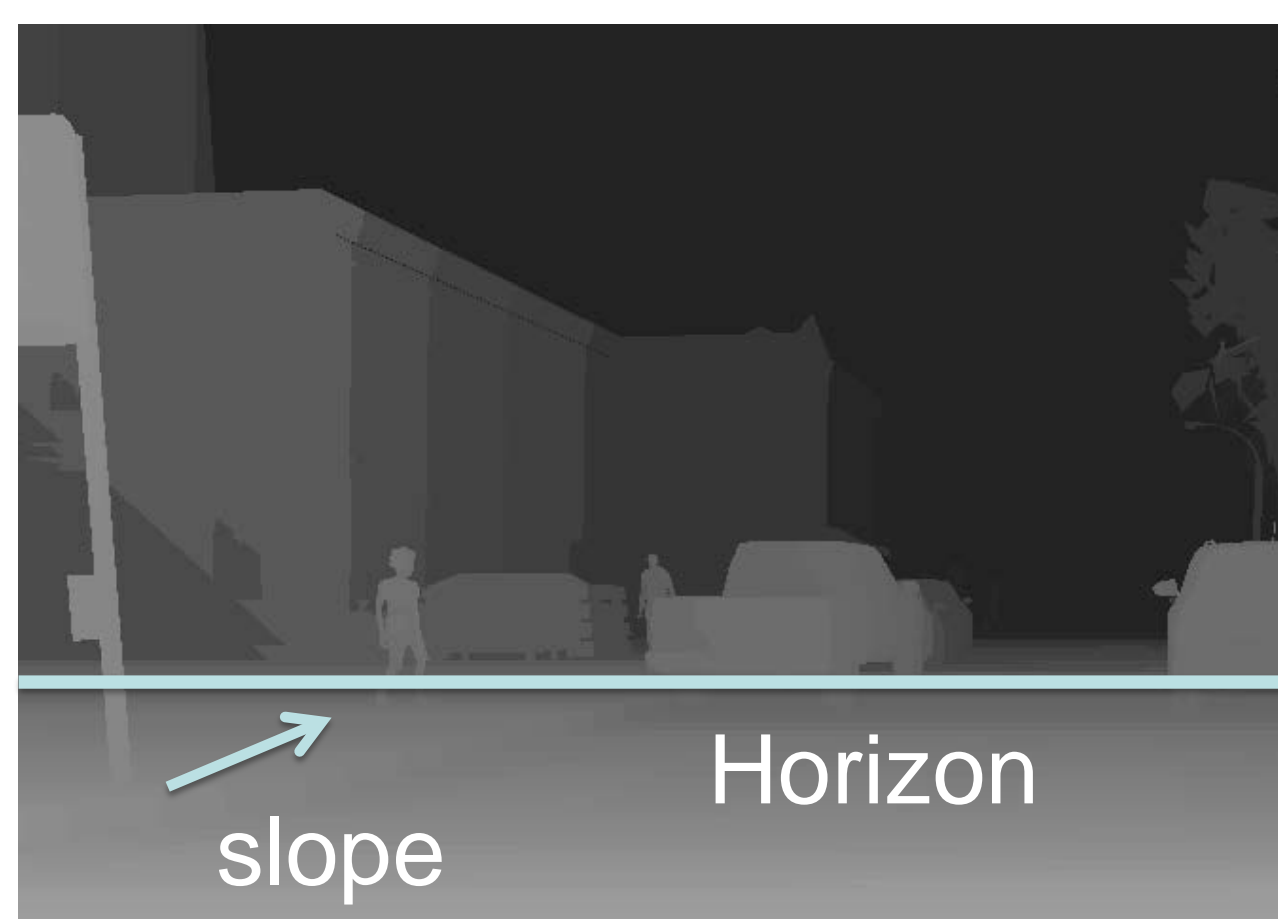
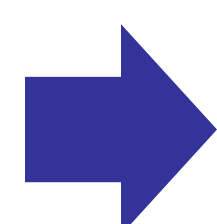
¹Computer Architecture & Operating Systems Dpt. — ²Computer Vision Center



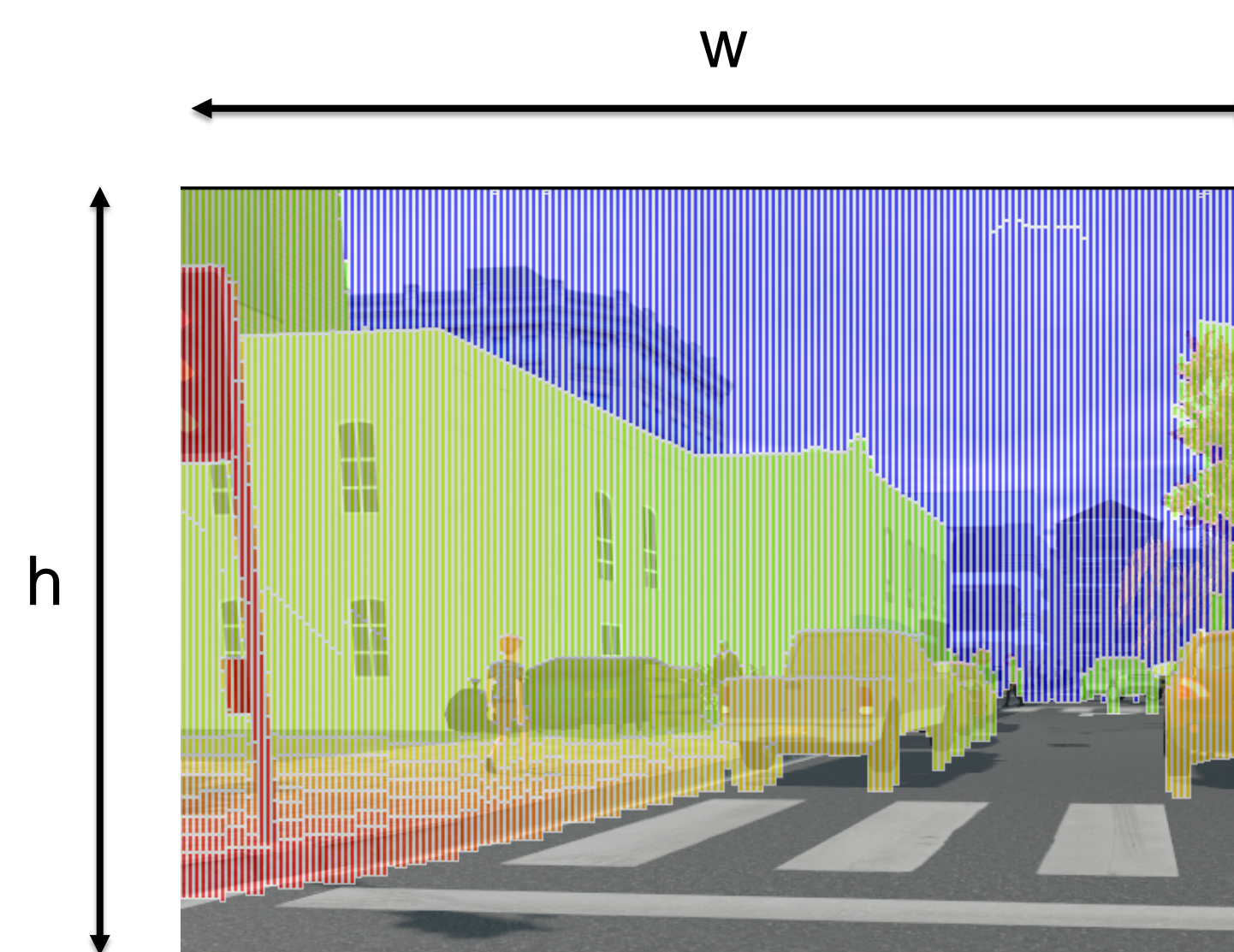
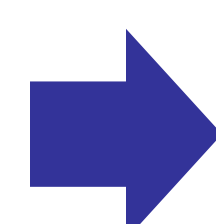
Problem: Compact depth representation



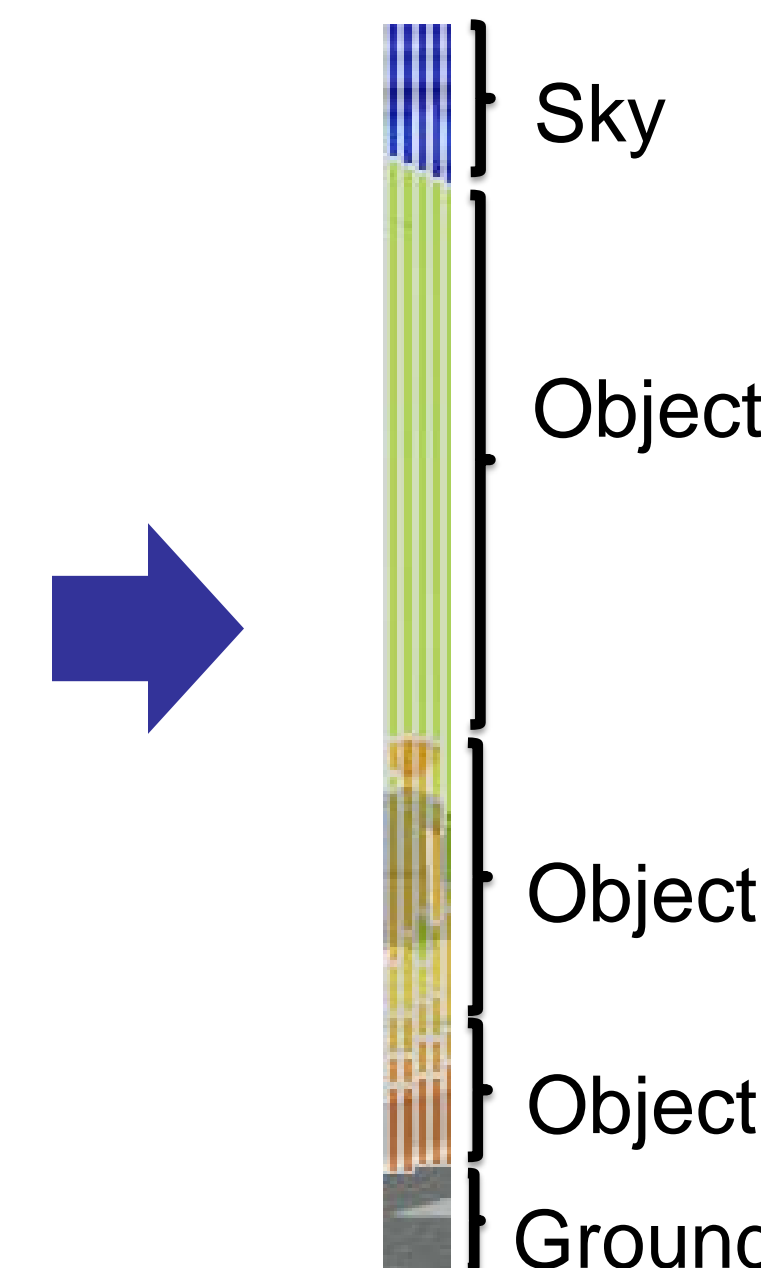
Stereo Images



Stereo + Horizon Line + Road Slope



Stixels

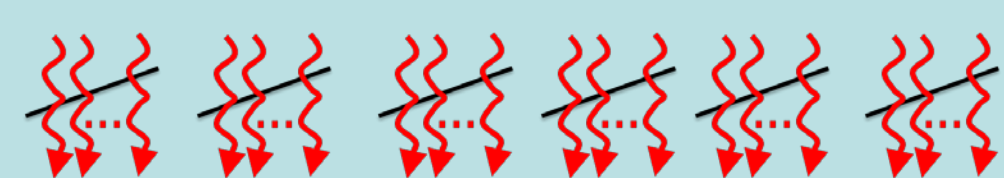


Stixels Overview

- Goal: Compact depth representation
- Extensions: tracking, grouping, semantics
- Dynamic Programming algorithm
- High computational complexity $O(w \times h^2)$

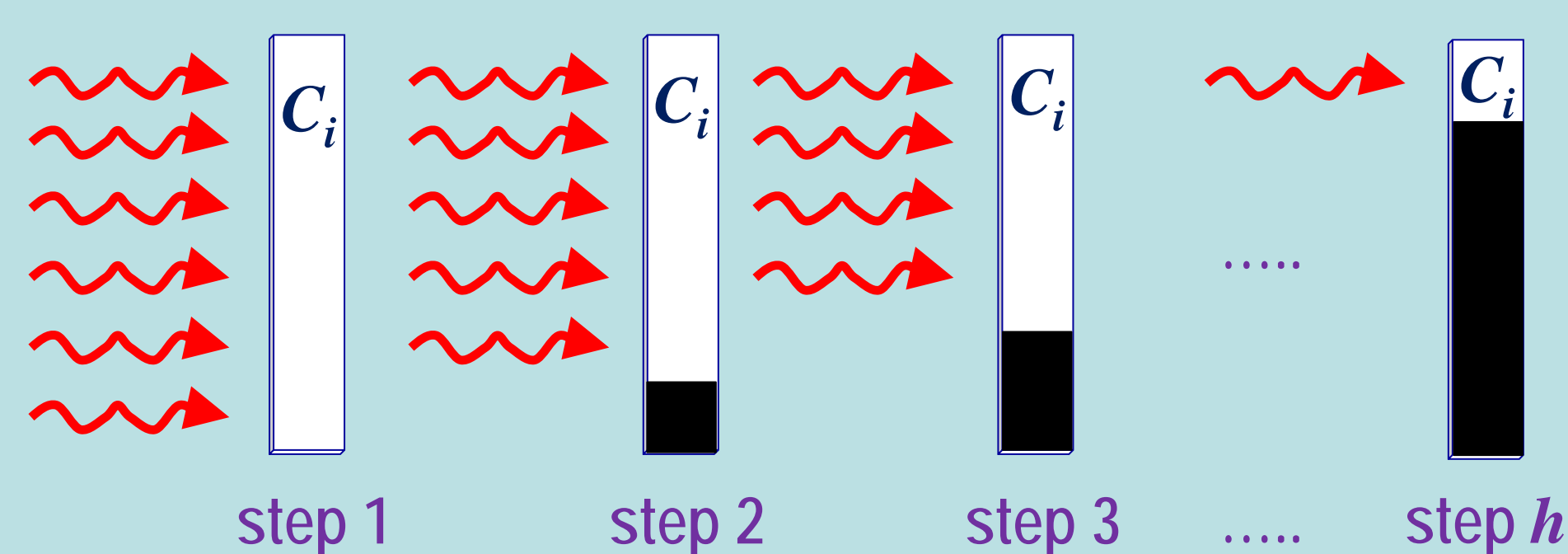
Parallelization

First level parallelism



- Independent / Task level: Typical CPU parallelization
- Each image column is processed by a CTA

Second level parallelism

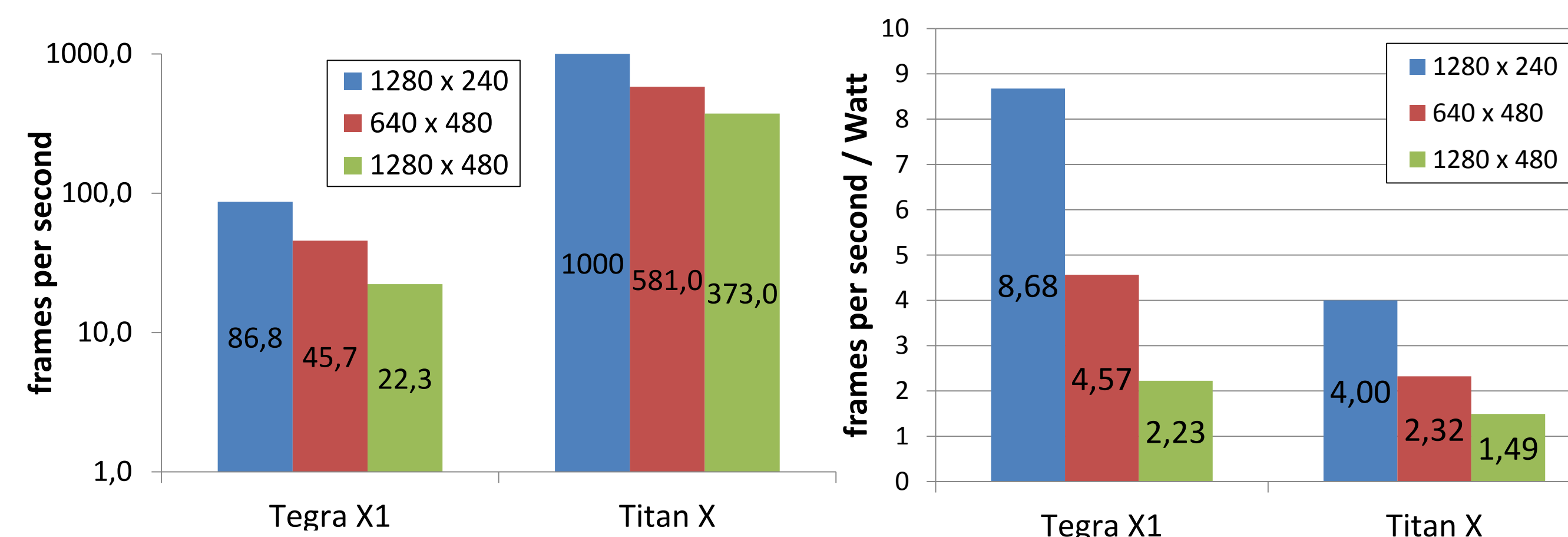


- Extra parallelism level needed for efficient GPU use
- Sequentially perform h (image height) steps
- CTA threads collaborate sharing info each step
- Decreasing Parallelism: Each step uses one thread fewer

Results

	FPS	Speed Up	FPS / Watt
CPU Multi-thread	13.3	1	0.10
GPU Optimized	413	31	1.65
NVIDIA Drive PX ¹	26	1.95	2.6

CPU: Intel Core i7 980X
 GPU: NVIDIA Titan X
 Drive PX: NVIDIA Tegra X1
 Image Size: 1024x440
¹ single-socket



Conclusions:

- Real-time performance for energy efficient GPU Tegra X1
- Tegra X1 has better energetic efficiency than high-end GPUs