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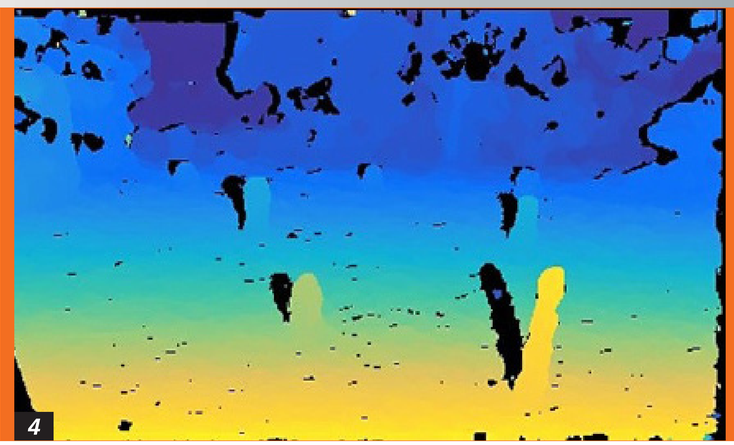
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REAL-TIME HYPERSPECTRAL STEREO PROCESSING FOR THE GENERATION OF 3D DEPTH INFORMATION

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Contributions

- Hyperspectral image data (16 channels) with considerably more information as RGB data.
- 3D reconstruction of unstructured outdoor environments (Fig. 3, Fig. 4) with real-time capability.

Concept

- Correlation-based stereo matching using CCRADAR algorithm on hyperspectral images (Fig. 5).
- Process correlations of superpixels.
- Evaluation and optimization using image data from technology demonstrators (Fig. 1 to Fig. 3).

Stereo processing on GPGPU with CUDA

- Optimization focusing on runtime and parallelization.
- Processing of 8 - 13 dispartiy images (Fig. 4) per second on NVIDIA M6000 depending on maximum disparity value.
- Approx. 28 times faster on GPU than on CPU (Tab. 1).

Results

- 3D depth information for unstructured outdoor environments can be generated in real-time.
- Mean square error of 0.0267 m² in measuring distances up to 10 m.

Tab. 1: Timing results on CPU and GPU with maximum disparity of 80.

Step	$t_{CPU,disp=80}$ in ms	$t_{GPU,disp=80}$ in ms	speed-up
Init	3.68	2.05	1.80
Color Census	502.79	4.79	05.56
SAD	228.34	1.04	218.76
SGDx	155.60	2.80	55.62
SGDy	144.50	3.39	42.64
Sum weighted cost	43.66	4.66	9.36
Guided Filter	434.32	25.56	16.99
Disparity selection	25.89	1.37	20.28
Guided Filter	432.46	25.47	16.98
Disparity selection	26.55	1.37	19.33
Consistency check	0.74	0.85	-
Total	1998.53	73.32	28.16

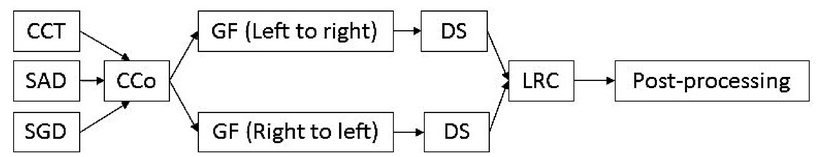

Fig. 5: Processing pipeline of correlation-based CCRADAR algorithm.

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