



AKADEMIA GÓRNICZO-HUTNICZA
IM. STANISŁAWA STASZICA W KRAKOWIE

Evaluation of MoG Video Segmentation on GPU-based HPC System

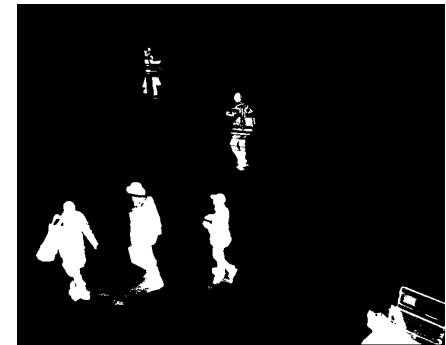
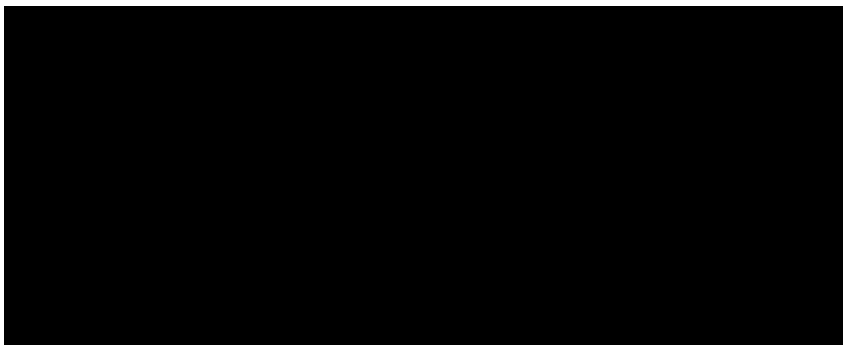
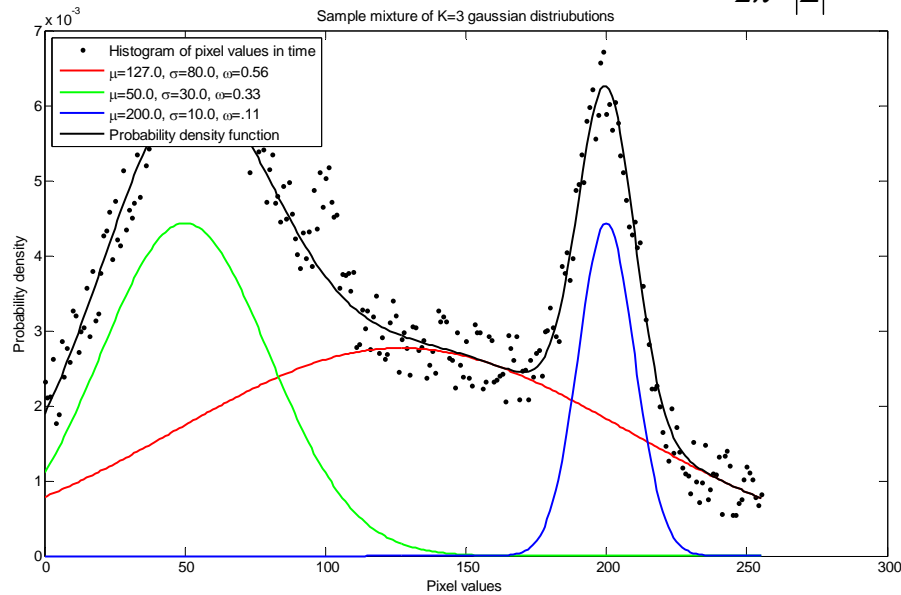
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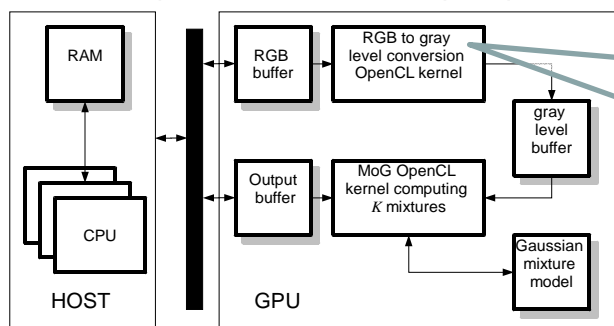
Gaussian Mixture Models models for background- foreground segmentation

$$P(X_t) = \sum_{i=1}^K \omega_{i,t} \eta(X_t, \mu_{i,t}, \Sigma_{i,t}) \quad \eta(X_t, \mu_{i,t}, \Sigma_{i,t}) = \frac{1}{2\pi^2 |\Sigma|^{\frac{1}{2}}} e^{-\frac{1}{2}(X_t - \mu_i)^T \Sigma^{-1} (X_t - \mu_i)}$$



Evaluating OpenCL implementation on GPU

Video resolution	Hardware configuration	K	GPU			CPU	Speedup: GPU vs CPU	Theoretical GPU throughput	
			kernel time [ms]	transfer time [ms]	total time [ms]	computing time [ms]		[Mpixel/s]	[fps]
720 × 576	GPU-HPC node: NVIDIA Tesla M2090, Intel Xeon E5645 2.4GHz	5	1.48	0.50	1.98	16.31	8.24	205	505
		10	3.42	0.50	3.97	20.68	5.20	102	251
2456 × 2048	M2090, Intel Xeon E5645 2.4GHz	5	19.68	3.31	22.99	199.31	8.67	214	43
		10	46.35	3.29	49.64	252.40	5.44	99	20
720 × 576	PC workstation: NVIDIA GTX670, Intel i5 3570 3.4GHz	5	1.42	0.85	2.26	13.20	5.84	179	442
		10	2.98	0.80	3.79	17.76	4.68	107	263
2456 × 2048	Intel i5 3570 3.4GHz	5	19.09	4.28	23.37	113.07	4.84	210	42
		10	39.24	4.35	43.59	135.82	3.11	113	22



```

__constant sampler_t smp =
    CLK_NORMALIZED_COORDS_FALSE |
    CLK_FILTER_NEAREST |
    CLK_ADDRESS_CLAMP_TO_EDGE;

__constant float4 grayscale = { 0.2989f, 0.5870f, 0.1140f, 0 };

__kernel void rgba2gray(
    __read_only image2d_t src,
    __write_only image2d_t dst)
{
    const int2 gid = { get_global_id(0), get_global_id(1) };
    const int2 size = { get_image_width(src), get_image_height(src) };
    if(!all(gid < size))
        return;

    float4 rgba = read_imagef(src, smp, gid);
    float gray = dot(grayscale, rgba);
    write_imagef(dst, gid, (float4) gray);
}
    
```

