CUDA Acceleration of Color Histogram Matching

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A common approach to histogram matching is done by means of the cumulative distribution functions (CDFs). First, we calculate their normalized histograms ($h_A$ and $h_B$) and their respective cumulative histogram distribution functions (CDF$_A$ and CDF$_B$). Then, a matching between the CDFs are performed. Given the reference CDF, CDF$_A$, for each gray level $G_I$ we find the corresponding gray level $G_J$ in which CDF$_A(G_I) = CDF_B(G_J)$, if $I$ and $J$ correspond to different values then a replacement of a gray level in the image $I$ is performed in order to match their CDFs. Our approach considers the ideas of [Rolland et al. 2000] with a Nvidia 3D broadcast solution system using professional HD cameras.


Image histograms are not very prone to parallelization because of the implicit direct access to the distribution container which can lead to race conditions. However, with the recent advances of the CUDA platform we can exploit the atomic operations in CUDA shared memory supported by compute capability 1.2 devices.