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Real-time simulation of motion-based camera disturbances.

Summary: In the RoboCup domain, many robot systems use low-cost image sensors to perceive the robot’s environment and to locate the robot in its environment. The image processing typically has to handle image distortions such as motion blur, noise, and the properties of the shutter mechanism. If a simulator is used in the development of the control software, the simulation has to take account for these artifacts. Otherwise, the performance of the image processing system in the simulation may not correspond to its performance on the real robot; it may even perform worse. The effect of motion blur has been widely used for special effects both for movies and for computer games. While real-time algorithms using modern graphics hardware came up in recent years, the image distortion resulting from a so-called rolling shutter has not been in focus so far. In fact, this effect is not relevant for gaming, but it is for simulating low-cost cameras of robots. In this paper, we present an efficient way to simulate the rolling shutter effect using per-pixel velocities. In addition, we improve the velocity buffer method for creating motion blur using the current speed of each pixel in real-time. The application of our approach is shown exemplarily for the head-mounted camera of a humanoid soccer robot.

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