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Ultra-High-Speed Imaging

Prof. Dr. Arno Ruckelshausen
Faculty of Engineering and Computer Science
Interdisciplinary Research Center Intelligent Sensor Systems (ISYS)



Fachhochschule Osnabrück
University of Applied Sciences



Overview

High-Speed Imaging

ISIS Architecture for 1 Million Frames per Second

Animation

Examples

Overview

High-Speed Imaging

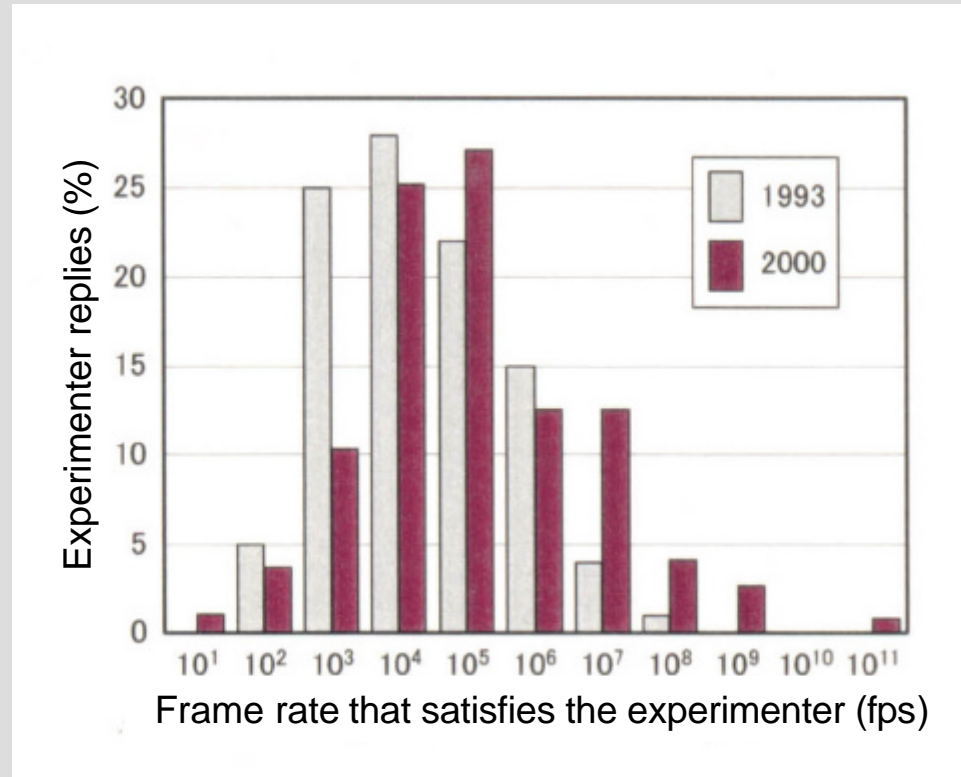
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Introduction

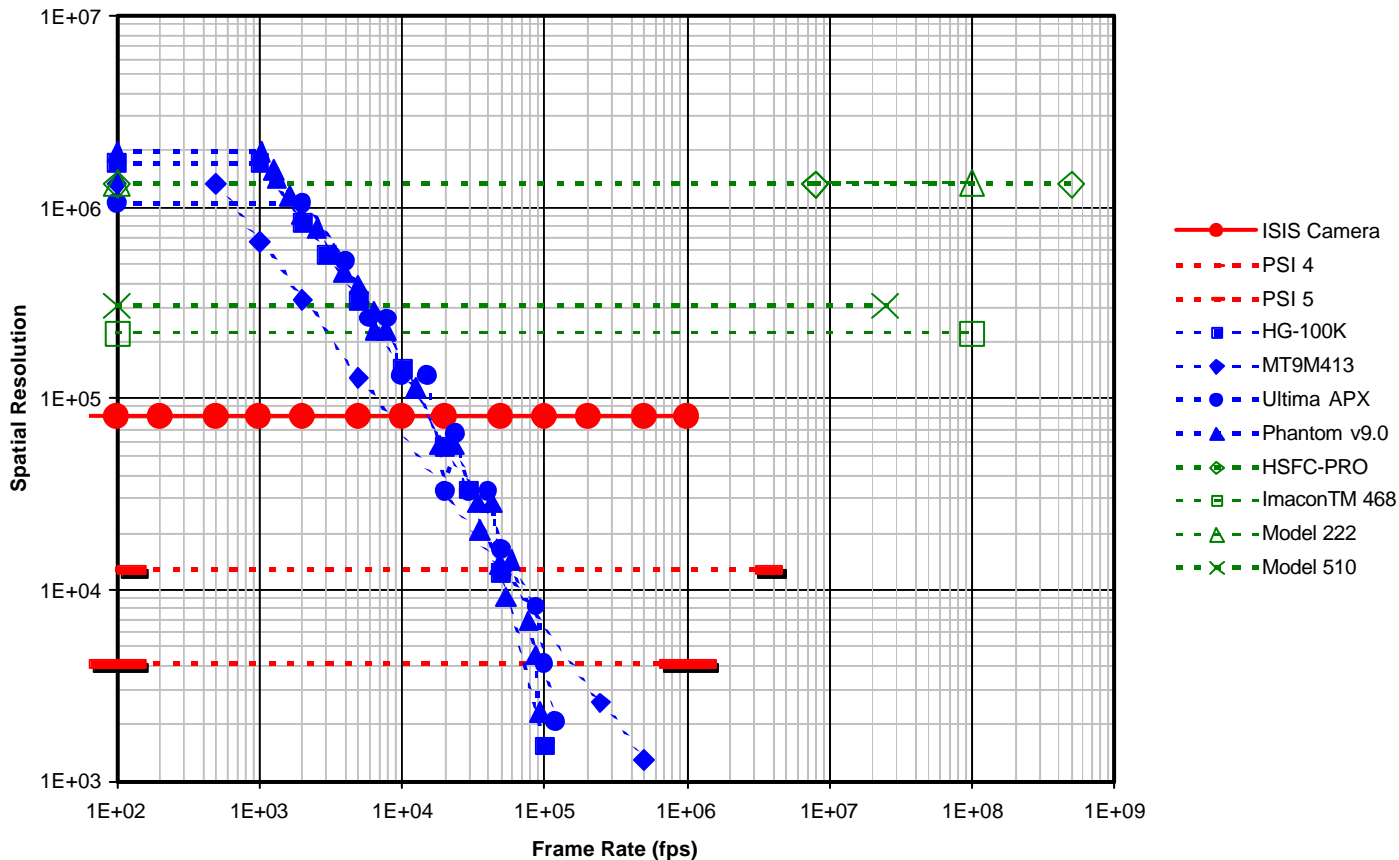
Market Analysis for High Speed Video Cameras



Source: T.G. Etoh et. al., „Development of High Speed Video Cameras“,
Proceedings of 24th International Congress on High-Speed Photography and Photonics, 2001

High-speed imaging

Comparison of digital high speed video systems, frame rate vs. spatial resolution



on-chip storage
dedicated sensors

parallel read-out
dedicated sensors

Mech. system
utilizing multiple
standard sensors

High-speed imaging

Comparison of digital high speed video systems

high speed reached by principle	Digital High Speed Video Systems			
	mechanical system with standard sensors		dedicated sensor architecture	
	multi-sensor system	on-chip storage	parallel read-out	on-chip storage, ISIS
Frame rate	++	+	○	+
Resolution	++	–	++	○
Total No. of Frames	○	–	++	○
Sensitivity (without intensifier)	–	–	○	+
Mechanical adjustment	--	--	+	+
Trigger	○	○	++	+
Image post processing	–	+	+	+
Price	–	+	+	+

++: very good; +: good; ○: satisfactory; –: average; --: below average

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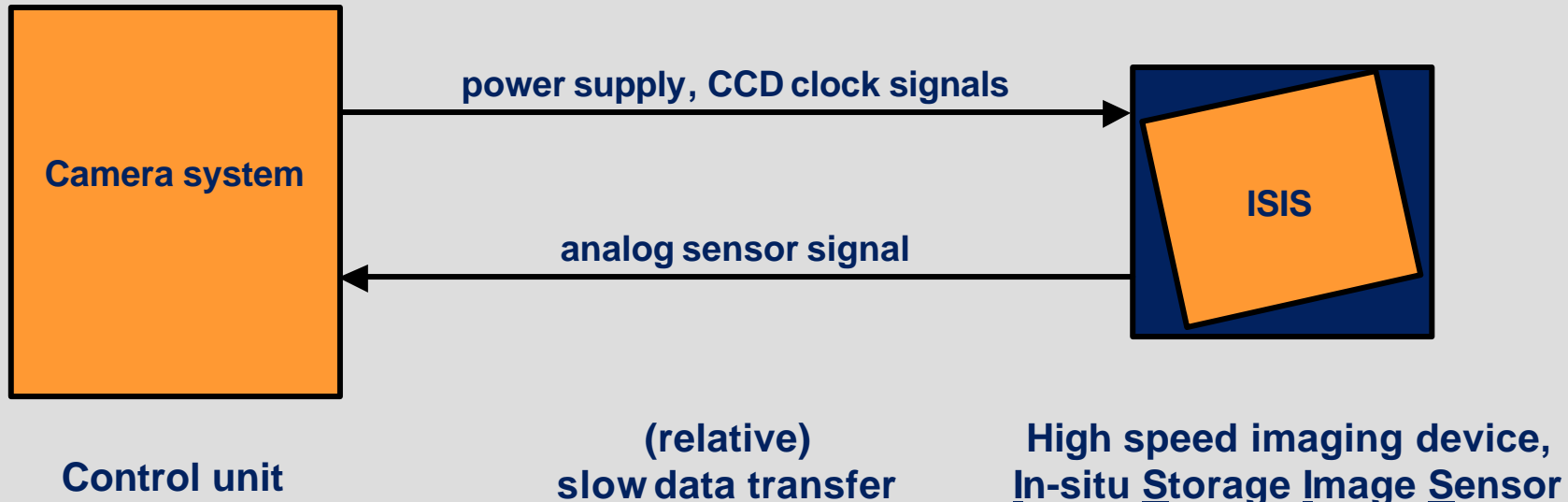
Examples

Concept and Architecture

Bottleneck for high speed video: Sensor read-out

Most promising concept to overcome the bottleneck:

Dedicated sensor architecture with on-chip- or in-situ-storage, each light sensitive CCD pixel is supplied with a CCD storage line



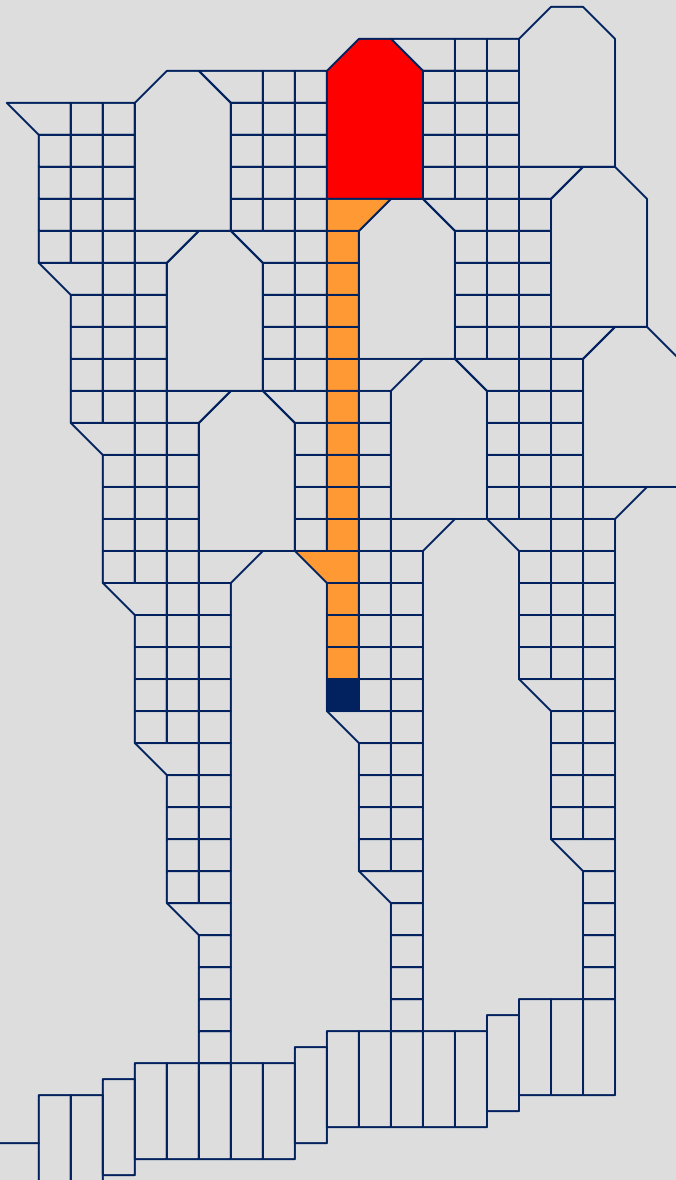
How to achieve 1 Million frames per second ?

Concept :

In-situ Storage Image Sensor (ISIS)

- Each pixel has an own storage section.
- A limited number of images is stored.
- Image storage is started by a trigger signal.





Basic operation



Light sensitive pixel



Covered storage pixel



Covered overwriting pixel



Horizontal register

Device simulation: 3D FEM-Simulator SPECTRA

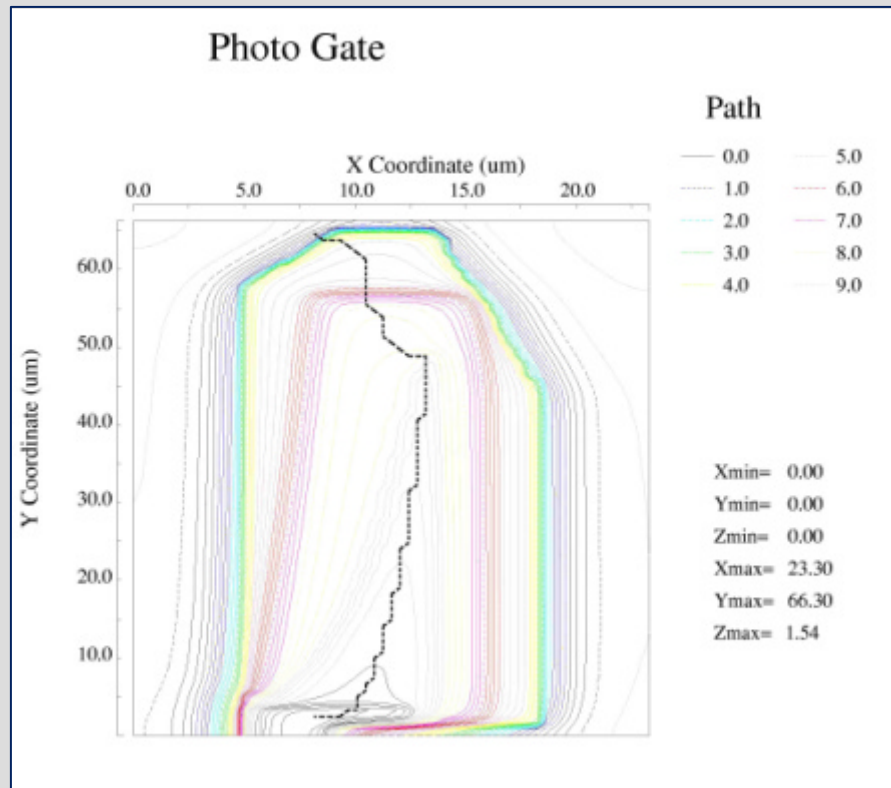
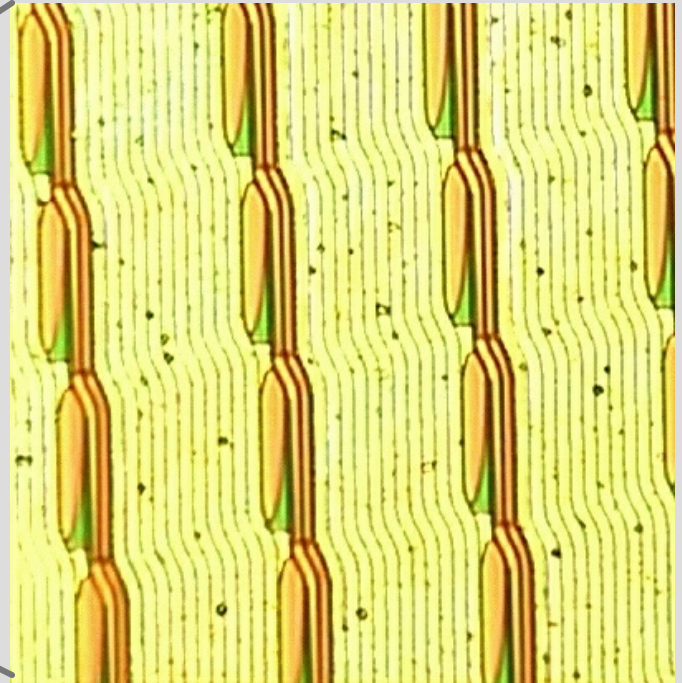
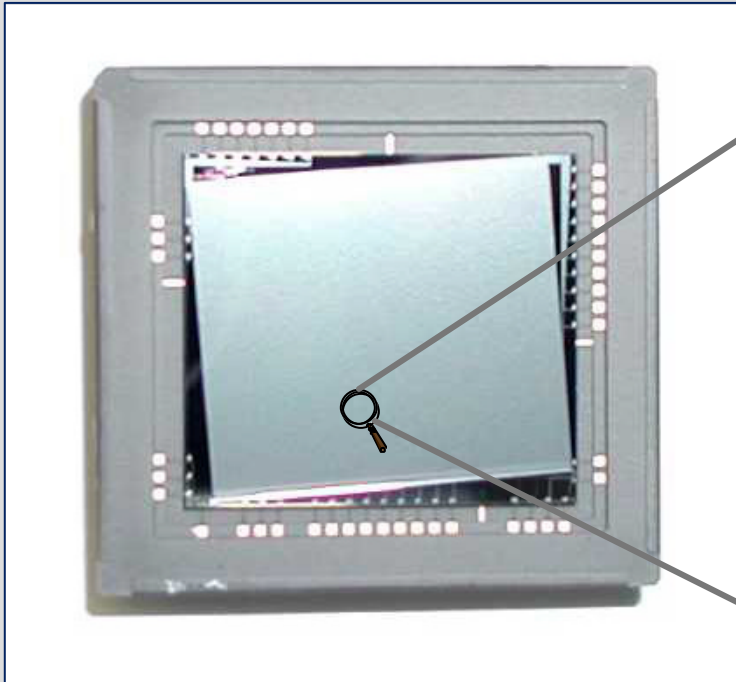


Image Sensor: Ultra high-speed Imaging (1 Million fps)



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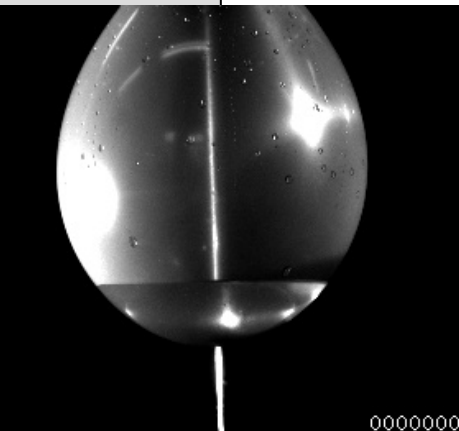
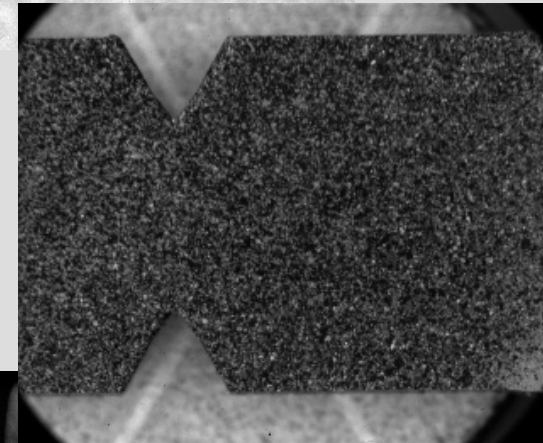
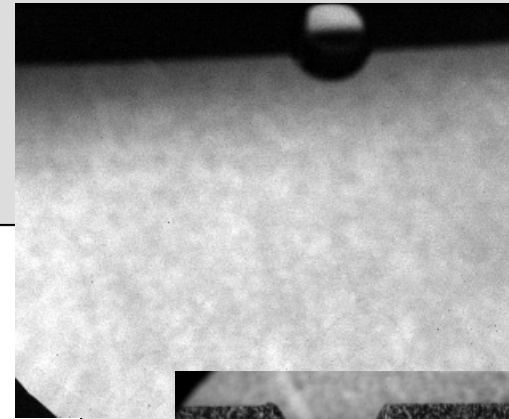
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HyperVision Camera: Examples



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