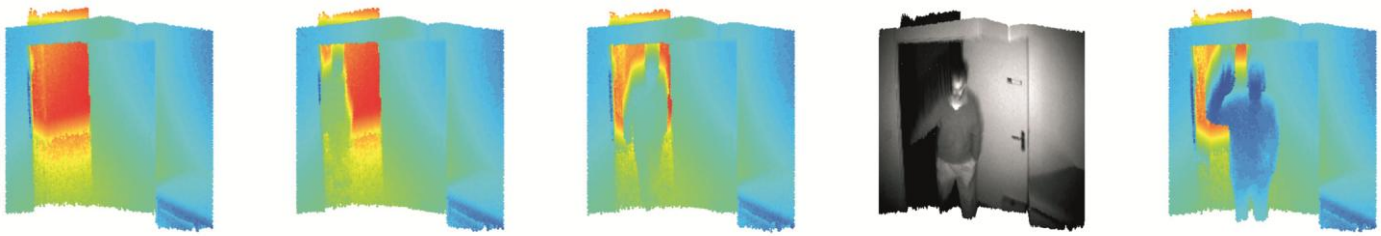
MESA IMAGING

3D Time-of-Flight Cameras

Thierry Oggier

December 2010



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Content

- Company profile
- Time-of-flight (TOF) technology
  - History
  - Principle
  - SwissRanger product
  - Challenges
- Applications
- Outlook

Who we are

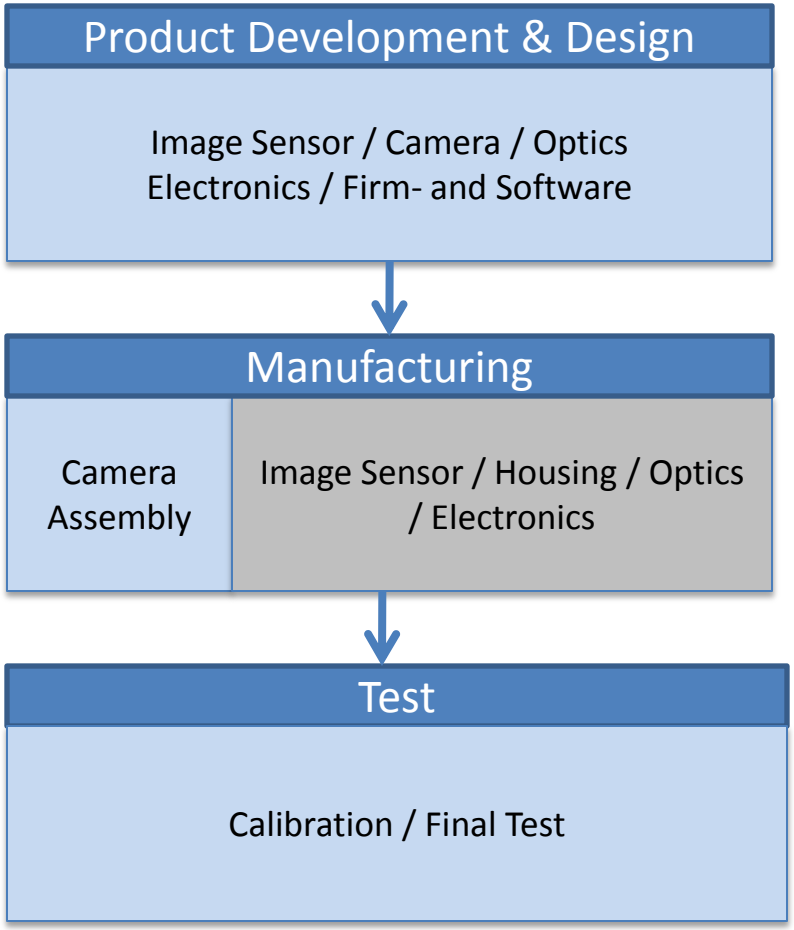
Company Profile

- **Foundation** — **July 2006**
  Spin-off from CSEM
- **Location** — **Technopark Zürich**
- **Financing** — **Series A in 2007**
  Series B in 2009
- **Employees** — **2006: 6 (at founding)**
  Today: 25

Electronics design, IC design, software design, mechanical design, optical design, testing, production, marketing & sales

Who we are

Business Model



- TOF camera company
- Product development in house
- Fabless semiconductor manufacturing
- Lean in-house production
- Flexible and scalable

Mesa Imaging internal

external

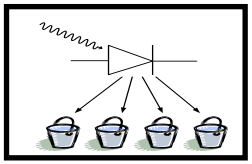
Our Technology

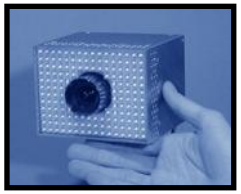
Technology History

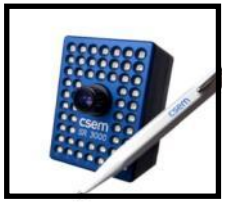
Award winning technology!

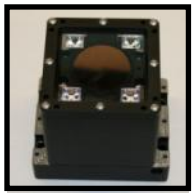
IST Grand Prize	2004
Swiss Technology Award	2004
Photonics Circle of Excellence	2005

- **1994** **1st patent application** CSEM
- **1997** **Proof of Principle** CSEM
- **2000** **1st 3D-TOF camera** CSEM
- **2001** **1st industrial R&D** CSEM
- **2003** **SwissRanger 2** CSEM
- **2006** **SwissRanger 3000** **MESA**
- **2008** **SwissRanger 4000** **MESA**
- **- today** **Customizing SR4000** **MESA**

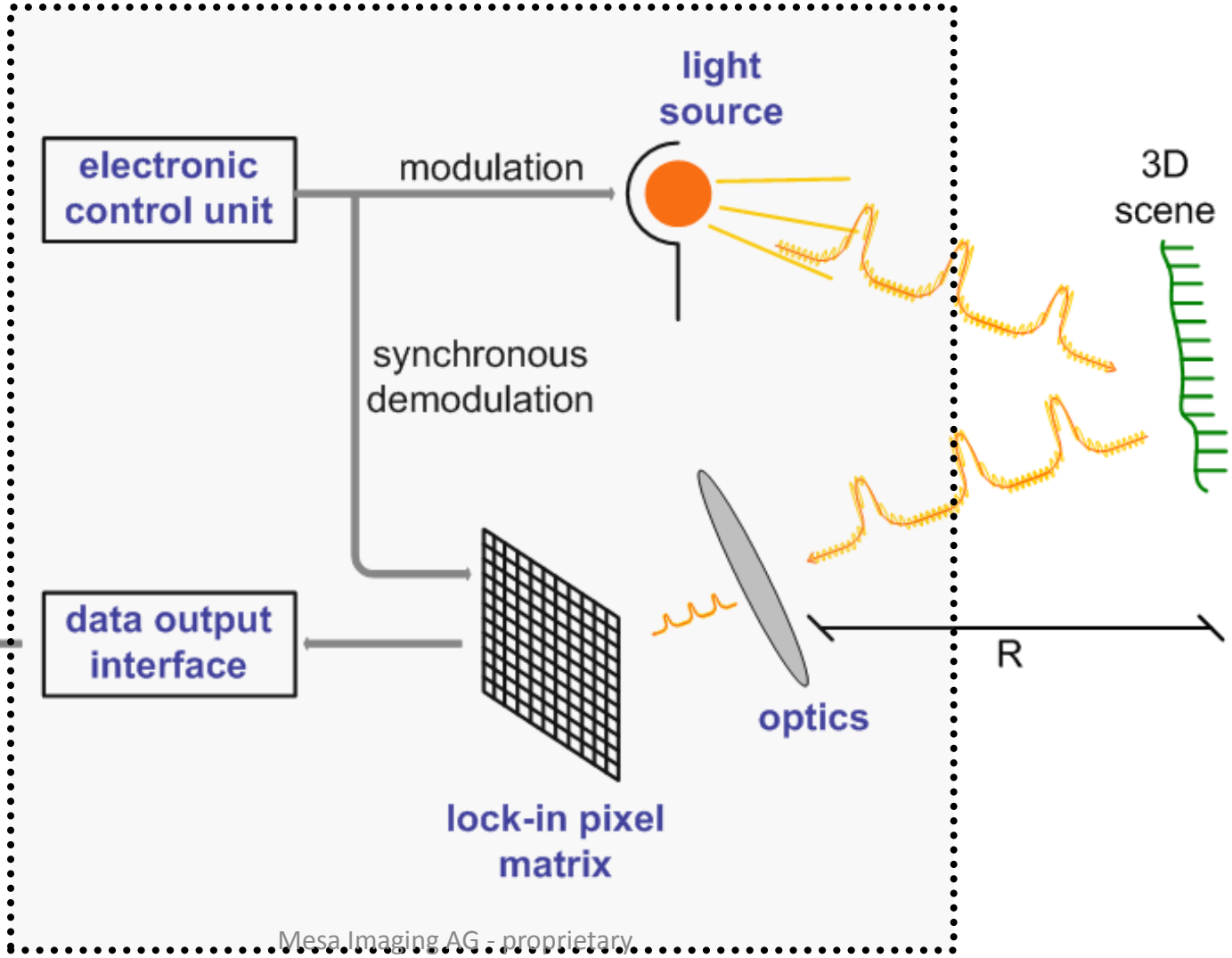






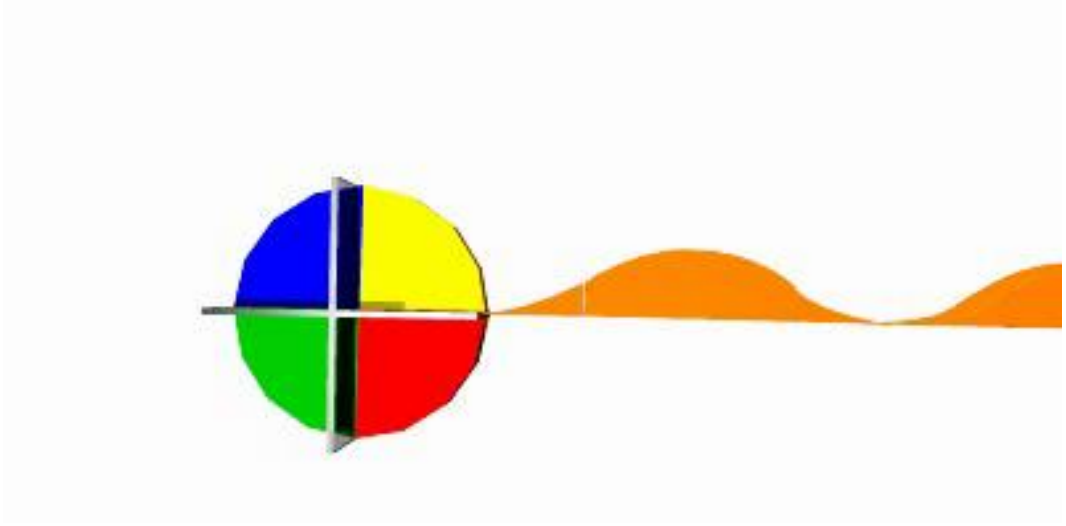


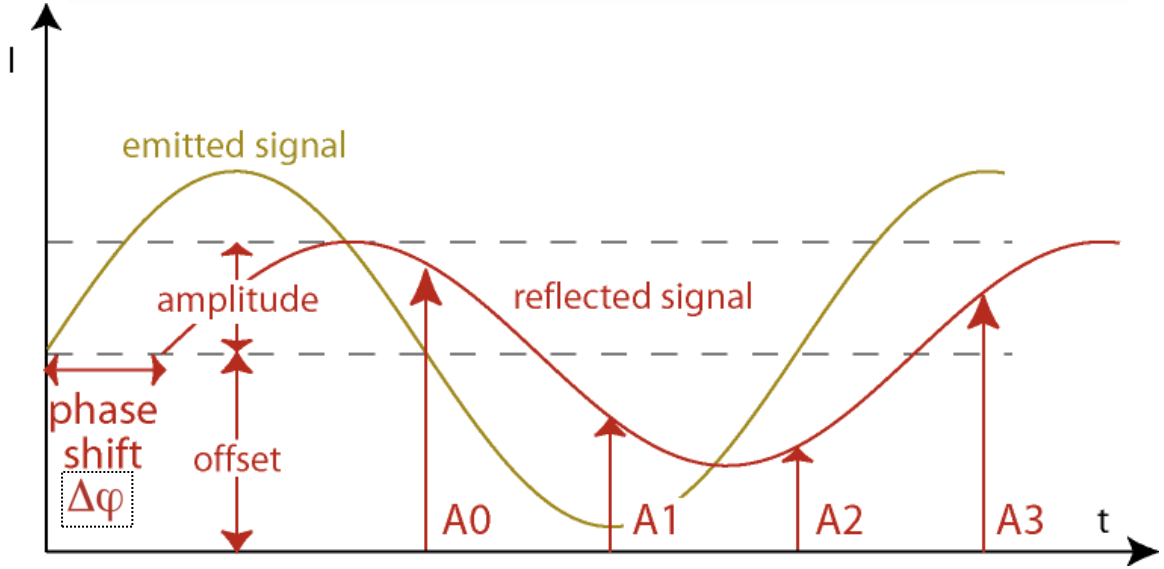
Time-of-Flight Imaging - Principle



e.g. color-coded images

Time-of-Flight Imaging - Principle





b/w image

$$B = \frac{(A_R + A_G + A_B + A_Y)}{4}$$

Accuracy

$$A = \frac{\sqrt{[A_R - A_B]^2 + [A_G - A_Y]^2}}{2}$$

Distance

$$\varphi = \operatorname{atan}\left(\frac{A_R - A_B}{A_G - A_Y}\right)$$

Time-of-Flight Imaging - Swiss Ranger SR4000

Parameter	Unit	Value
Pixel array size (x,y)		176 (h) x 144 (v)
Field of view	°	43 (h) x 34 (v) / 69(h) x 55 (v)
Frame rate	fps	Up to 50
Measurement range (z)	m	0 .. 5 / 0 .. 10 (optional)
Weight	kg	0.47
Operating temperature	°C	10..50
Interface		Ethernet / USB (optional)
Dimensions	mm	65 x 65 x 68 (USB) 65 x 65 x 73 (Ethernet)
Platform		Windows / Linux

Time-of-Flight Imaging - Swiss Ranger SR4000

- Robust, industrial grade housing
- Self calibrating optical design for stable measurements
- In-pixel background light suppression
- Very good absolute accuracy and repeatability
- Embedded image processing option

Time-of-Flight Imaging - Challenges

- Stability / calibration (speed of light!)
- Background light suppression
- Multiple reflections
- Multi-camera operation
- Frame rate
- …

Machine Vision / Robotics

- Navigation
- Obstacle avoidance
- SLAM

Application example:

Warehouse robots
Automatic pick-up and delivery of pallets
Operation in harsh or dangerous environments
Integration in warehouse management system

Medical / Rehabilitation

- Interactive rehabilitation via game-based movement

Agriculture

- Milking robots
- Herd management

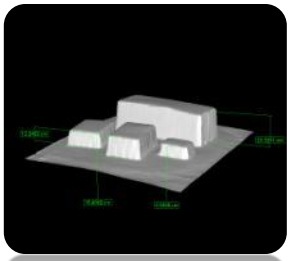
Application Example:

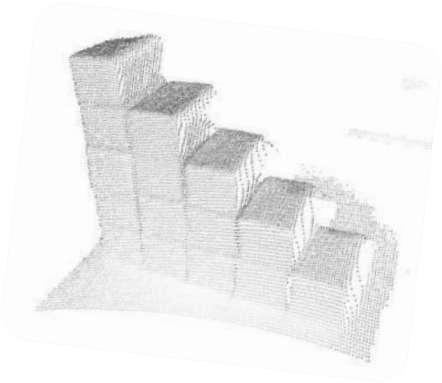
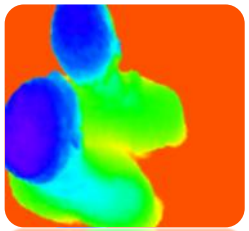
Customer specific camera for milking robot
Very robust / hermetic (IP67)
Embedded image processing

Outlook

- Business
  - Spreading in existing markets
  - Identify new market segments
- Technology
  - Higher resolution in x,y and z
  - Faster image acquisition / increase sensitivity
  - Improved background light robustness

Mesa Imaging AG



Thank you for your attention!