



Time-of-Flight Data Processing - Challenges and Solutions -

International Time-of-Flight Workshop March 11th 2014, Ein Gedi, Israel

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- ... well, this is a Siegencentric view of life ;-)
- Location
 - 1 h east of Cologne
 - × 1.5h north of Frankfurt
- University of Siegen
 - × Founded in 1972
 - × Some 18.500 students
- × Sensor science focus in Fac. Science & Engineering
- × C
 - Spin off
 PMD Technologies



- Initiator of ToF activities: Prof. Dr. Rudolf Schwarte
- 1997: 3 SPIE papers by the Schwarte group
- German Patent DE 19704496 A1, 1998: "A method and apparatus for determining the phase and / or amplitude information of an electromagnetic wave"
- Nominated for the German Future Award 2002 (conferred by the Federal President)







 October 2004: German Research Foundation (DFG) round table meeting "3D Vision with PMD" in Siegen initiated by R. Schwarte



- × Research projects funded by the German Research Foundation (2006-2010)
 - PMD simulation, calibration and scene acquisition
 - E.g.: 3D panorama for pose estimation (R. Koch, U Kiel)



- Research projects funded by the German Research Foundation (2006-2010)
 - PMD simulation, calibration and scene acquisition
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- Large scale industrial research project (2006-2009; 10 industrial partners, 5 universities, 12M€)
 - Applications: Autonomous robots, object detection & tracking





Historical Remarks: Workshops

- Workshop "Dynamic 3D Imaging", DAGM, Heidelberg, Germany, 2007 (105 participants, 20 presentations & posters)
 - Follow up special issue of IJISTA, vol 5, no 1&2
- Workshop "3D ToF-cameras", IEEE-ISSCS, Iasi, Romania, 2007
- 1st PMD Vision Day, Airport Munich, January 2007
- CVPR Workshop "Time-of-Flight Camera Based Computer Vision", Anchorage, 2008
 - Follow up CVIU special issue vol 114, no 12
- Workshop "Dynamic 3D Imaging", DAGM, Jena, Germany, 2009 (13 papers, Spinger LNCS 5742)
- 3rd PMD Vision Day, Airport Munich, 2010. ("Door opener" talk by Giora)
- Dagstuhl seminar "Time-of-Flight Imaging: Algorithms, Sensors & Applications", 2012
 - Follow up Springer LNCS 8200 (15 contributions)



Intensity Modulation Approach

- Photonic Mixing Device (PMD):
 - Active time-of-flight approach
 - Intensity modulation of incoherent light (NIR)
 - Correlation of reference signal and optical signal
- "Smart pixel" realizes a photo mixing detector to sample the