Session 12

Lectures:

Advanced Lithography Qualification Techniques

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The IC manufacturing roadmap for 45nm design rule and below foresees immersion optics at 193nm wavelength and low k1-lithography factor. This leads to lithography mask design with advanced resolution enhance techniques (RET) such as phase shift mask (PSM) and optical proximity correction (OPC). The mask manufacturing tolerances are getting tighter and the overall development and qualification cycle is getting longer.

The procedure for properly implementing OPC for a new technology node or chip design involves multiple steps: selection of the RET, OPC model building, OPC Verifications, critical dimension (CD) control quantification (across chip, mask, wafer, etc.), calibration of optical rule check (ORC) and others.

To meet this challenge, and to shorten the development and qualification cycle, a new mask inspection technique based on aerial imaging and a direct link technology from the design systems to the process metrology tools were developed. These novel applications enable automated generation of metrology and inspection qualification recipes directly from the design inputs. This design based metrology (DBM) framework provides the common language and interface that facilitates the direct transfer of the desired measurement locations from the design to the metrology tool.

In this paper the entire qualification cycle of advanced lithography mask and manufacturing process will be discussed. The significant benefit of OPC-check application based on mask inspection with aerial imaging and DBM will be presented

Video Mosaicing for Surveillance

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Three powerful effects of video mosaicing for surveillance will be described:
- Generating 3D panoramic mosaics, presenting the 3D structure of the scene.
- Generating dynamic panoramic mosaics while canceling camera motion. This enables easier detection of moving objects.
- summarizing a long surveillance video in a very short video, without losing any activity.

In all cases a sequence of images scanning a scene are aligned and represented as an "aligned 3D space-time volume". A new "summary" video of the scene is generated by sweeping a "time front surface" through this space-time volume. Each such "time front" corresponds to a new image generated from the input.

Quantitative Measurements of Biological Systems in the Light of Microfluidics

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Background/aim: Genetically identical populations of cells show variability which is attributed to "biological noise". Our aim is to quantify precisely this variability in order to understand the mechanisms governing the biological systems.

Methods: We develop novel microfluidic devices that can trap single cells under the microscope in controlled environmental conditions. The devices are fabricated using soft lithography layers, in which a transparent membrane was inserted. They allowed the separate growth of single bacteria under varying conditions in micro-channels. We then quantify the response of bacteria to various stimuli by automated microscopy and image analysis.

Results: Our measurements reveal that bacterial populations spontaneously differentiates into distinct sub-populations. Each sub-population can be characterized by the dynamics of its response to an external stimulus.

Conclusions: The use of microfluidics allowed quantitative measurements and analysis of bacterial populations dynamics that was not attainable otherwise. The observed inherent heterogeneity of bacterial populations may play an important role in the persistence of bacterial infections to antibiotics.

Study of Image Enhancement methods for the Visually impaired

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In this presentation we report on a proposed image enhancement techniques for implementation in a low vision aid device, which is currently under development at the Ben Gurion University and the Holon Institute of Technology [1]. The Proposed approach allows a significant improvement in the scene visibility for visually impaired to be achieved. It is widely recognized that the mere compensation of contrast sensitivity loss is inadequate for low vision image enhancement and that it must be accompanied by other methods in order to obtain meaningful results. There are numerous reports by low vision researchers, indicating that unbalanced contrast enhancement in natural scene images lead to a major rejection of these enhancement schemes by the visually impaired. This is because the global contrast enhancement method results in the appearance of effects such as the "dazzling camouflage" , which is utilized in nature by frogs and zebras. This is why a controlling mechanism for contrast masking must be implemented in order to combine the Global Enhancement operation with the suppression of secondary value features. Our Proposed approach is aimed at avoiding the saturation of the enhancement effect caused by the pooling mechanism in the visual cortex. Using this approach, only salient image details are enhanced while the surrounding, low value edges and texture elements are partially suppressed.

The efficiency of the image enhancement process using our approach, is measured by the observer's discrimination capability and subjective rating based on preserving the natural view of the image. In modeling the image discriminability of the visually impaired , we consider both effects of retinal eccentricity and scene illumination level on the observer's spatial frequency response .

[1] Efron U., David I., Apter B., Thirer N., Baal Zedaka I., Ben-Guigui A., Levy O., Nater P. "A head-mounted, image transceiver-based, low vision aid". Vision 2005 - Proceedings of the International Conference, April 4-7 2005, London, UK. Elsevier International Congress Series, vol. **1282,** 2005 .

HIGH RESOLUTION MICROSCOPY BASED ON SINGULAR BEAMS

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Quickly developing nanotechnology drives the need for fast but sensitive nano-scale feature evaluation. Currently there is an empty niche of a speedy investigation of non fluorescent material with ~20 nm or less sensitivity. In our research we address this need by introducing an optical singularity into the beam, scanning a surface with nano-scale features. The introduction of an optical singularity enables to achieve the required sensitivity. The proposed method is based on a previous research of the Dark Beam. In general, the investigation technique can be viewed as micro-scaled interferometer with its arms separated by distance of an order of a micron. Experimental results show 20nm sensitivity, while simulations indicate the potential of 1 nm sensitivity for 30dB signal to noise ratio (using numerical aperture of 0.4). In order to analyze the experimental or simulation results, some basic but effective algorithms were developed. They enable to utilize an excessive data collected and to convert it to signal to noise ratio gain. In addition to the presentation of the method itself, its possibilities and applications are discussed.

Computer Vision for Automotive Applications

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Automotive applications using computer vision are becoming mainstream. This talk will start with a survey of the applications we are seeing or likely to see in the near future and the core technologies that are required to support them such as lane, vehicle and pedestrian detection. The talk will then move on to discuss some of the technological challenges of computer vision system design in this domain, which has strict and often conflicting requirements.

On the one hand the algorithms require considerable computing power to work reliably in real-time and under a wide range of lighting conditions. On the other hand, the system cost must be kept low, the package size must be small and the power consumption must be low. In addition, automotive qualified parts must be used both to withstand the harsh operating environment and to guarantee long product life.

METHODS AND CHALLENGES IN OVERLAY METROLOGY

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Semiconductor circuits, so ubiquitous in our lives today, are produced by a lithographic process. As a result of this process, thin patterned layers of various materials are placed on top of each other, with very tight requirements both for feature size and for lateral misplacement error (overlay error). The tolerances for the overlay error are rapidly approaching the single-nanometer regime. The requirements for the metrology of overlay error, true to the age-old rule of thumb, are a tenth of overlay error itself, and have already been pushed down to a nanometer.

In our paper we will describe some of the methods and challenges of overlay metrology from the various perspectives involved in the process. These include overlay target design, overlay metrology tool strategies, and the utilization of overlay metrology data for lithography process control.

Studies of Iris Recognition algorithms

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Currently there exists a great need for a reliable, rapid and non-intrusive means for an automatic biometric identification of people.

Iris recognition is one of several biometric identification methodologies, which utilizes psychological and physical characteristics of humans.

The iris has a highly detailed and unique texture, which remains unchanged with aging, and is therefore one of the most accurate methods for biometric identification.

The state of the art method developed by Daugman[1] is based on a 2-bit phase encoding extracted from Gabor filtering applied to the angular intensity distribution of the Iris.

Following a short overview of the Iris recognition technology and status, we present a novel approach for the Iris's feature vector encoding . The method is based on the use of different combinations of phase and amplitude information encoding, using Log-Gabor filters. This is further compared against Daugman's state-of the art algorithm which relies only on the phase information extracted using linear Gabor filters.

The algorithm is also compared with Kovesi's algorithm, which implements iris feature vector encoding using Log-gabor filters with a 2 bit phase information[2].

Preliminary results of adding amplitude information to the 2-bit phase information, indicate an approximate Equal Error Operating Point (EEOP) of 0.088% for a 2bit-amplitude/2bit-phase encoding, as compared to Kovesi's 2-bit phase encoding, which yields an approximate EEOP of 0.15%. It thus appears that the inclusion of amplitude information results in a significant improvement of the current phase-only methods. Finally we present an expansion of this method where the radial intensity distribution of the iris, in addition to the currently used angular distribution, is incorporated into the feature vector, lending further accuracy to the method.

[1] J.Daugman ,"*High confidence visual recognition of persons by a test statistical independence*", IEEE Trans.Pattern Anal. Machine Intell, vol. 15(11) :1148-1161,November 1993

[2] P.Kovesi,"*Image features from phase congruency*" videre .journal of computer Vision Research,1(3):1-26,1999

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CONTRAST MECHANISMS IN TERAHERTZ IMAGING WITH APPICATIONS IN SENSING AND INSPECTION

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A detailed account of contrast mechanisms in terahertz imaging will be given together with examples from our imaging experiments. We explain electro-magnetic and spectroscopic aspects that enable these contrasts, with emphasis on the needs of real life applications. Relations between these constraints and terahertz imaging system parameters will be discussed. These features of terahertz contrasts have unique advantages for detection, identification and characterization of various materials and objects, with applications in remote sensing, in forensic sciences, medical diagnosis in inspection, materials defects and reliability as well as in many other fields.