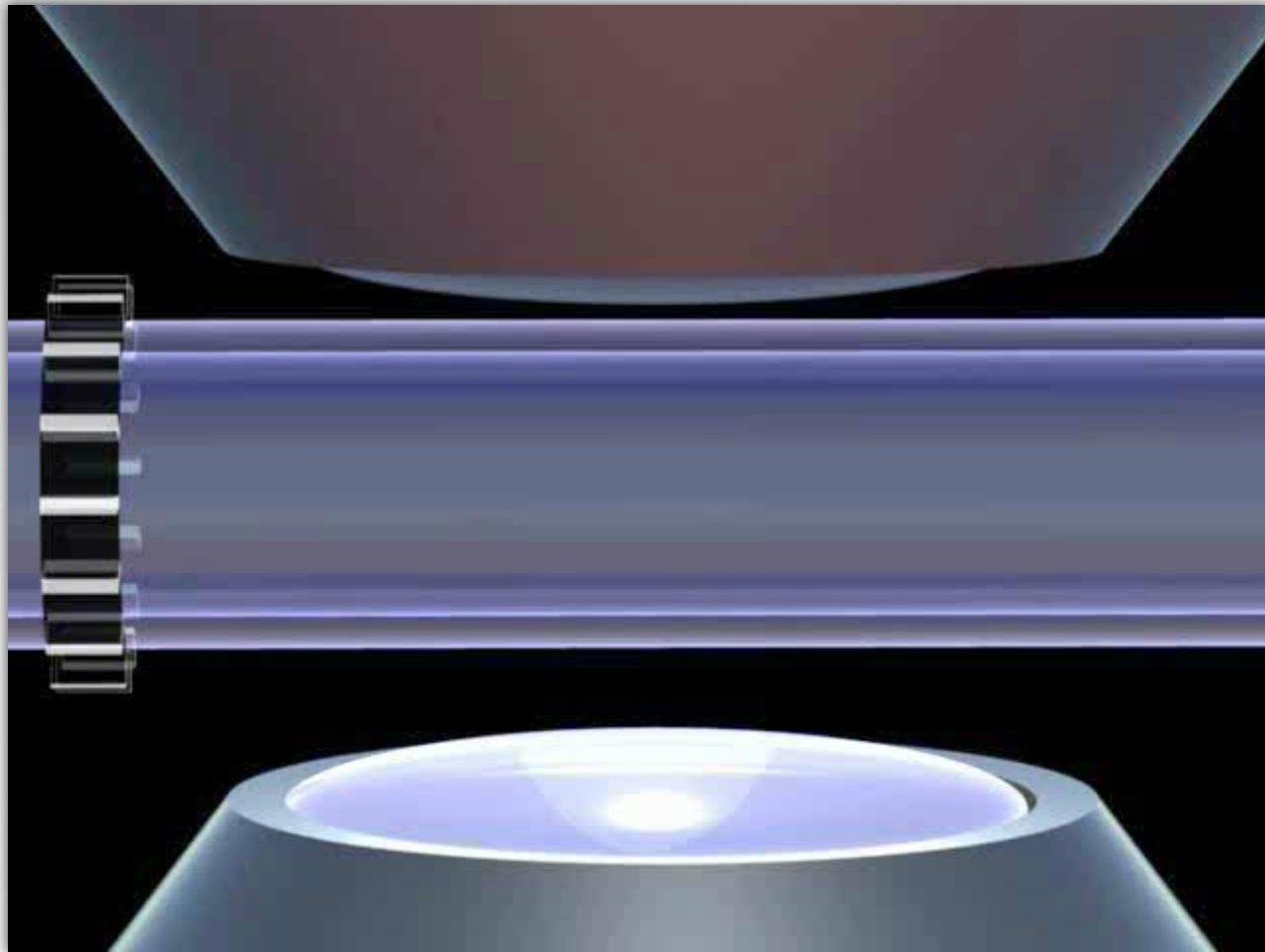


The Lung Cell Evaluation Device (LuCED): Early Detection of Lung Cancer in Sputum Based on 3D Morphology

Michael Meyer

Vice President for Image Engineering

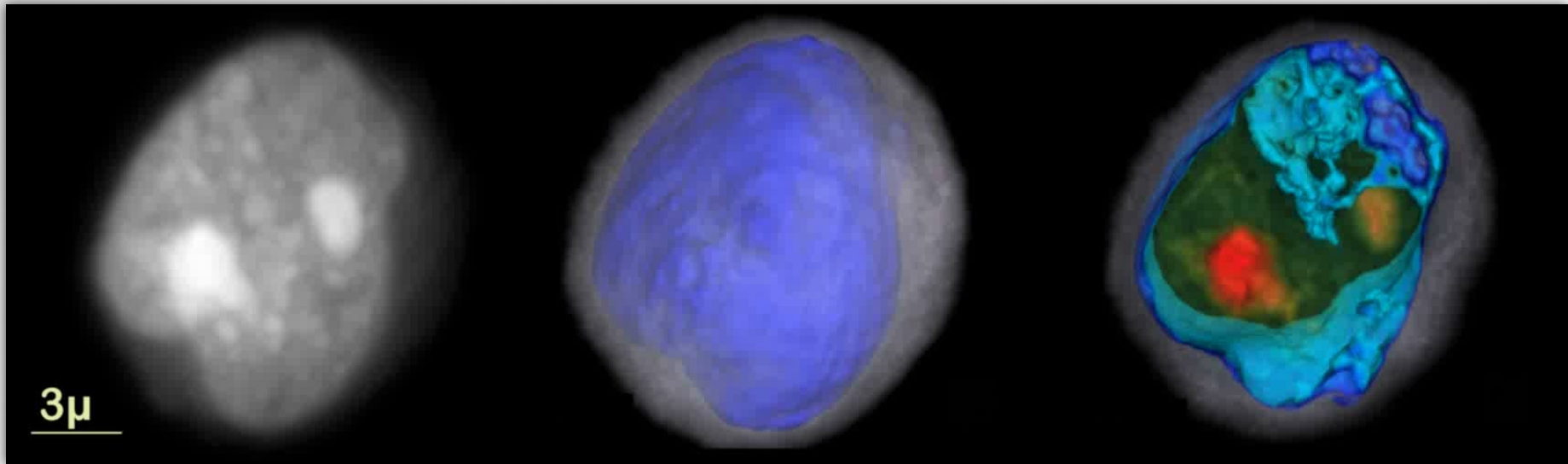
Cell-CT System



**Sub-micron, Isometric Resolution 3D
Reconstructions on the Cellular Scale**

3D Morphology for Automated Cancer Detection

Squamous Cancer Cell (H358) – Hematoxylin Stain



3D Cell Analysis Using the Cell-CT

- ◆ Unambiguously represents cell features



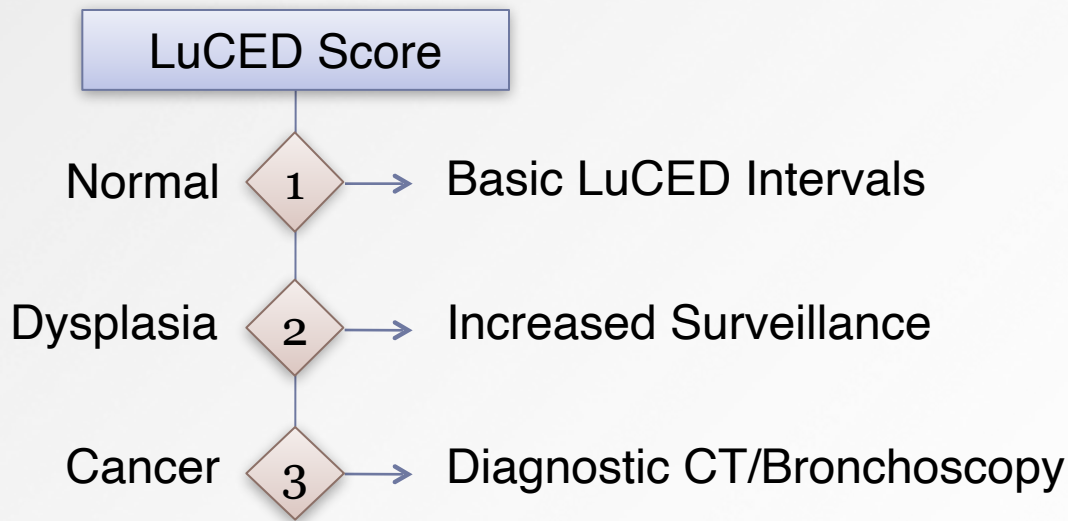
“Automated cell analysis in 2D and 3D:
A comparative study”

Pattern Recognition 42 (2009) 141 – 146

- ◆ Standardized, high precision, automated cell analysis

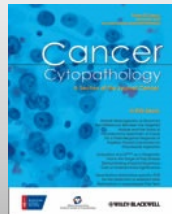
Lung Cancer Triage Using LuCED

- ▶ LuCED: Lung Cell Evaluation Device
- ▶ A non-invasive test to assess cancer risk and for surveillance
- ▶ Induced or spontaneously collected sputum specimen
- ▶ Cell Prep
 - ▶ Enrichment for epithelial cells
 - ▶ CytoLyt fixation, hematoxylin stain
- ▶ Macrophage detection for assessment of adequacy
- ▶ Lung cell morphometry is highly specific for dysplasia/cancer



Abnormal Cell Rates in Sputum

- ▶ Study Design
 - ▶ Analysis of a (non-VisionGate) phase III trial on sputum cytology for lung-cancer
 - ▶ 444 patients confirmed for primary lung-cancer upon follow-up
 - ▶ Induced and spontaneous sputum
 - ▶ Blinded review by multiple Cytopathologists
- ▶ Results
 - ▶ Dysplastic and cancer cells observed for 75% of patients
 - ▶ Cancer observed for 49% of patients
 - ▶ Dysplasia and cancer cell rate consistency:
 - ▶ Stage: I - 65%, II - 70%, III - 77%, IV - 83%
 - ▶ Type: Adenocarcinoma - 72%, Squamous Cell - 78%, Small Cell - 75%



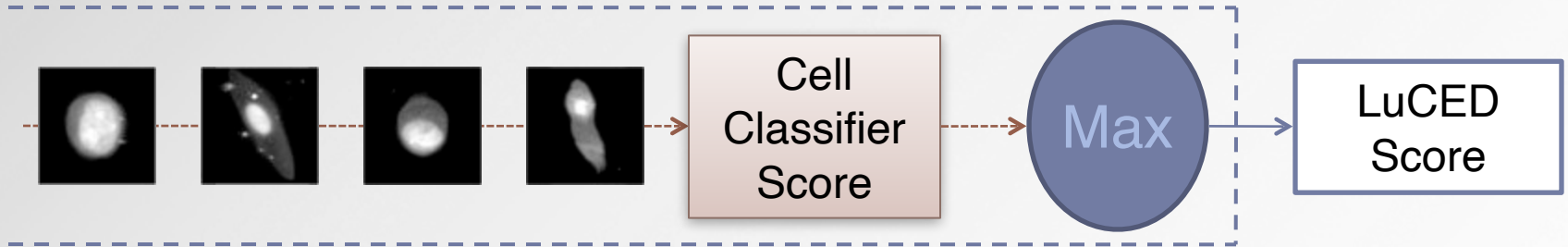
“Premalignant and Malignant Cells in Sputum from Lung-Cancer Patients”

Accepted for publication in the Journal of *Cancer Cytopathology*

Cell Classification with LuCED

- ▶ Training producing software to recognize abnormal cells
 - ▶ Cell populations
 - ▶ Normal cells (N= 2976) from sputum
 - ▶ Adenocarcinoma (N=879) from culture & tissue
 - ▶ Cell and nuclear segmentation
 - ▶ 576 possible features
 - ▶ 8 of 576 features → cell classifier score
- ▶ Individual cell classifier score performance
 - ▶ ~100% specificity attained with software:
 - ▶ Cell sensitivity: 70% adenocarcinoma

LuCED Score Performance



- ▶ LuCED score is the maximum of all individual cell classifier scores in the specimen
- ▶ What is the optimal number of cells for best LuCED performance?
- ▶ LuCED specimen performance
 - ▶ 1,000 cells processed
 - ▶ ~100% specificity
 - ▶ >90% sensitivity to specimens with cancer cells

Summary

- ▶ High resolution, Cell-CT 3D cell volumes + LuCED abnormal cell recognition software may match any cell diagnostic standard
- ▶ Many possible applications – LuCED enables triage to guide clinical decisions for further diagnostic and localizing tests

Questions

Ciliated Epithelial Columnar Cell

5 μ

A grayscale micrograph of a single ciliated epithelial columnar cell. The cell is elongated and has a distinct, darker, rounded apical region at the top, which is the site of the cilia. The basal region is narrower and appears lighter. A horizontal scale bar is located in the lower-left corner of the image, labeled '5μ'.