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## Advances in bioengineering transform traditional to computational next generation pathology: Single cell analysis and high-throughput image cytometry applications in pathology and microscopy using virtual flow image cytometry

A significant trend is taking place in bioengineering and pathology, which appears more evident in the former. In pathology, cancer has been traditionally diagnosed using a microscope and visual cues and discerning skills of the pathologist. Computational pathology promises to augment diagnosis from a descriptive to an annotative approach useful for treatment, prognosis, and discovery. New pathology may not only use microscopic images for diagnosis, but automatically convert these images into objective meaningful metrics applicable not only in diagnosis, prediction but also in systems biology, molecular informatics, and in general augment the discovery and treatment of cancer. One large facet of this movement is the idea that multi-disciplinary collaboration is essential. The role of genomics, transcriptomics, proteomics and other 'omics' over the years suggests an idea that the treatment paradigm based on organ-based cancer diagnosis is less important than identifying the particular cancer's meaningful biomarkers. Much current literature suggests that multi-organ cancers of seemingly different types contain the same targetable cellular pathways and key biomarkers. The challenge will be to apply the new methods to pathology and oncology so the data become useable information. In this context, the microscope as a tool for discovering cancer, validating tissue metrics will be shown. We contribute to this trend by inventing microscopic digital image analysis tools using next generation high throughput novel segmentation strategy for single cell instead of area-based analysis. We will show some examples of this approach and compare those from commercial approaches. Either approach may additionally minimize the prevalent practice of "gestalt" estimation of histopathology or immunohistochemistry diagnostic visual cues or results. Super-resolution, multispectral, advanced microscopy and image cytomics advances are current advances as well as the non-invasive light or multispectral tools that help early diagnosis and complement pathology. In general, imaging (in both radiological and microscopic) will be essential to help diagnose, predict drug response and validate targets. This trend includes using molecular biomarkers, Nano medicine, and imaging to precisely characterize a person's cancer and the individual's immune response. Discovery and diagnostic characterization of pathways linking oncogenes, tumor suppressor genes and immune checkpoints are data-rich for bioengineering apps and offer ongoing opportunities for professional and biomedical engineers.

### Biography

Hernani Cauling is a consultant to major national labs like Quest, Ameripath, Neogenomics and University of South Florida and Moffitt Cancer Center. In that area, he has published two textbooks: Wiley's Non-Neoplastic Hematopathology and Springer's Cutaneous Pathology, the latter showing chapters with examples of the application of virtual flow cytometry in cutaneous pathology. He has put together a small team composed of a patent lawyer, a computer engineer, and a medical doctor as a seed group to develop this technology further, which is still in the incubation stage. In the past, he obtained external support for these projects from Whitaker Foundation and philantrophic individuals but has not pursued the scaling of the invention to a large business.

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**Notes:**