Automated Whole Slide Image Screening for Prostatic Adenocarcinoma by Use of Spatially-Invariant Vector Quantization.

Jennifer A. Hipp, MD, PhD

Department of Pathology
University of Michigan
hippj@med.umich.edu
Overview

• Background on SIVQ
• Gleason score and prostate cancer
• SIVQ for detection of prostate cancer
• Demonstration
Spatially Invariant Vector Quantization (SIVQ)

Pixel: numerical value on the RGB color scale.
Vector: group of pixels

Vector quantization: type of data compression, re-represented as #

Spatially invariant: Ring-based vectors, continuous symmetry, faster computational performances vs square-based vectors (X, Y, translation and 360° rotation increases (millions) the possible matches.

Color values derived based on distance

001011010101001010...
Pixel value

Searches

0010110101010010001
0101001101011011101
1011000101011010101
1010010101010010101...
ENCODED
Automated Whole Slide Image Screening for Prostatic Adenocarcinoma by Use of Spatially-Invariant Vector Quantization (SIVQ).
Importance of Accurate Gleason Grading

Gleason score = Sum of the major + minor grade patterns

Gleason score + stage + [PSA] = directs management
Active surveillance vs radical prostatectomy

Diagnosis in grading is difficult due to:
- limited amount on biopsy
- lack of overt nuclear atypia
- overlapping features with benign mimickers

Precise quantification is required for Gleason grading.

Nevertheless: Grading can be subjective with inter and intraobserver variation.
Prostate Cancer Morphology

Major Criteria:

Architecture
- Small infiltrative acini
- Fused acini
- Cribiform
- Solid cells or cords of cells

Cytologic:
- Nuclear enlargement
- Hyperchromasia
- Prominent nucleoli

*Loss of basal cells*

Minor Criteria:

- Rigid luminal borders
- Amphophilic cytoplasm
- Luminal contents
  - Crystalloids
  - Blue mucin
  - Pink secretions
Overview of Workflow

Whole slide image → IMA Maker → SIVQ → Future Signout tools
The approach: a low and high power analysis
Cytologic atypia: Nuclear enlargement, Hyperchromasia, Prominent nucleoli

34/37 malignant glands: Sensitivity 92%, Specificity 90%
- Identified 122/180 glands
- 14 atrophic glands/90 benign glands
End with demonstration
Advantages of SIVQ

• User friendly, with wide applications.
• Real-time decision support.
• Pathologist-driven, as oppose to computer scientist.
• No training sets are needed
END WITH DEMONSTRATION
Color values derived based on distance from each centroid