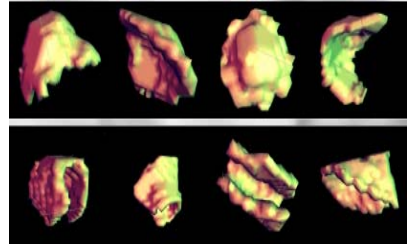


Shape Filtering for False Positive Reduction at Computed Tomography Colonography

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Introduction:

- Computer Aided Diagnosis (CAD) at Computed Tomography Colonography (CTC) is a non-invasive technique that is applied for **detection of colorectal polyps**.
- Aim of the CAD-CTC: Robust classification of complex colonic surfaces into polyps and folds with **high sensitivity and low incidence of false positives (FP)**.



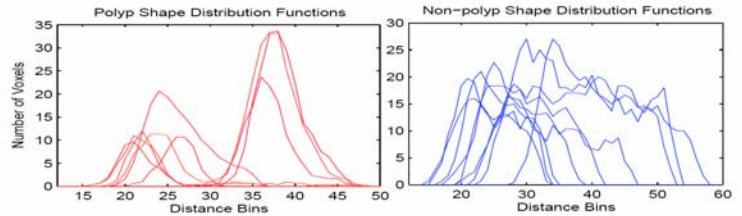
Polyps

Folds



Shape Distribution Function:

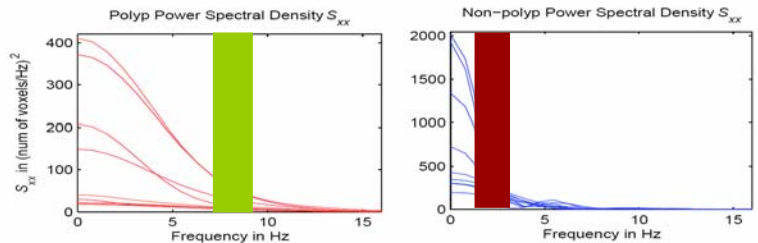
- The **Shape Distribution Function** records the **Euclidean distances between the centre of the candidate surface and the surface voxels**.
- Advantages:
 - Offers good primary discrimination between polyp and fold surfaces
 - Reduces the dimensionality of data from 3D to 1D, can be applied to real-time systems.
 - Geometrical feature invariant to rotation and translation.



SDFs of polyps and non-polyps surfaces from real-datasets shows significant differences in smoothness and maxima characteristics.

Power Spectral Density of SDF:

- The **peaks** in the SDF are located in direct relation to the size of the Polyp/Fold surfaces. Thus, **SDF cannot be applied directly** for robust polyp identification.
- Solution:** Calculate the Power Spectral Density (PSD) S_{xx} of SDF using the **Fourier transform of the autocorrelation function R_{xx}** .
- Polyp/Fold classification given by the **frequency at which PSD reaches 12.5% of its spectral power at DC frequency**.



Experimental Results:

- Our CAD system has been applied to phantom data and **real patient data (61 datasets)**.
- Experiments indicate that the performance of our system is in line with that offered by other developed CAD-CTC systems.

Table 1: Phantom Data (100 mAs)

| Polyp Type | Total Polyps | True Positives | Sensitivity % |
|------------|--------------|----------------|---------------|
| ≥ 10 mm | 14 | 14 | 100 |
| [5, 10) mm | 19 | 19 | 100 |
| < 5 mm | 5 | 4 | 80 |
| Flat | 9 | 2 | 22.22 |
| Total | 47 | 39 | 83.97 |

Phantom Dataset(100 mAs): FP = 1

Table 2: Phantom Data (60 mAs)

| Polyp Type | Total Polyps | True Positives | Sensitivity % |
|------------|--------------|----------------|---------------|
| ≥ 10 mm | 14 | 14 | 100 |
| [5, 10) mm | 19 | 19 | 100 |
| < 5 mm | 5 | 4 | 80 |
| Flat | 9 | 3 | 33.33 |
| Total | 47 | 40 | 85.11 |

Phantom Dataset(60 mAs): FP = 1

Table 3: Phantom Data (20 mAs)

| Polyp Type | Total Polyps | True Positives | Sensitivity % |
|------------|--------------|----------------|---------------|
| ≥ 10 mm | 14 | 14 | 100 |
| [5, 10) mm | 19 | 17 | 89.47 |
| < 5 mm | 5 | 3 | 60 |
| Flat | 9 | 2 | 22.22 |
| Total | 47 | 36 | 76.60 |

Phantom Dataset(20 mAs): FP = 0

Table 4: Phantom Data (13 mAs)

| Polyp Type | Total Polyps | True Positives | Sensitivity % |
|------------|--------------|----------------|---------------|
| ≥ 10 mm | 14 | 12 | 85.71 |
| [5, 10) mm | 19 | 18 | 94.74 |
| < 5 mm | 5 | 3 | 60 |
| Flat | 9 | 1 | 11.11 |
| Total | 47 | 34 | 72.34 |

Phantom Dataset(13 mAs): FP = 1

Table 5: Real Datasets (100 mAs)

| Polyp Type | Total Polyps | True Positives | Sensitivity % |
|------------|--------------|----------------|---------------|
| ≥ 10 mm | 10 | 10 | 100 |
| [5, 10) mm | 32 | 26 | 81.25 |
| < 5 mm | 104 | 62 | 59.62 |
| Mass | 11 | 7 | 63.64 |
| Flat | 2 | 1 | 50 |
| Total | 159 | 106 | 66.89 |

FP/ Real Dataset = 5.44