Mask Extraction Using Computer Vision Techniques

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Abstract

This report presents an advanced image processing pipeline for the segmentation of Scanning Electron Microscope (SEM) images. Our approach combines contrast enhancement, edge detection, and morphological operations to achieve precise isolation of specimen features while preserving critical surface details. The implementation demonstrates robust performance across multiple samples with varying surface morphologies.

1 Segmentation Results

Our algorithm demonstrates the progression from original SEM images to final segmentation results. Each figure shows three key stages of the process:

- **Original Image:** The unprocessed SEM micrograph
- **Segmented Inner Shape (Enhanced):** The processed image showing isolated specimen features
- **Enhanced Mask:** The binary mask used for segmentation

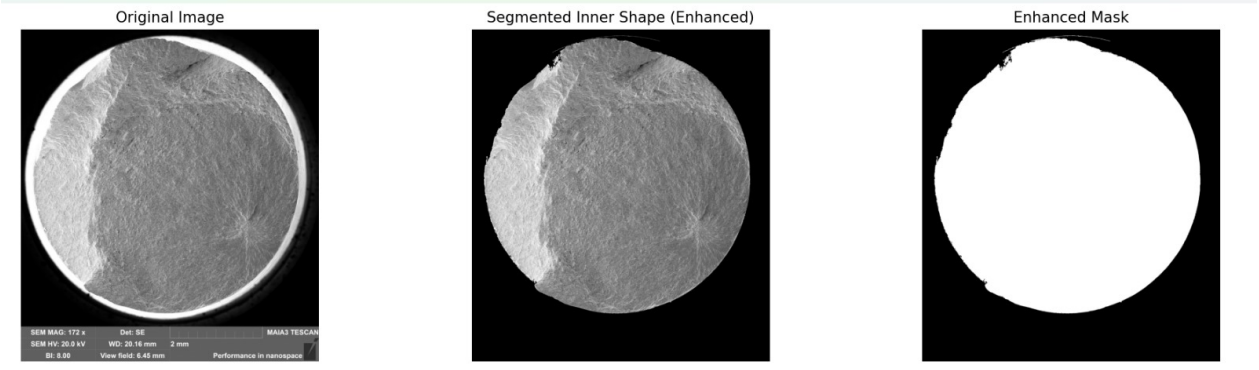

Figure 1: First specimen analysis showing: Original SEM image (left), Segmented Inner Shape with enhanced features (middle), and Enhanced Mask (right). The segmentation successfully preserves the specimen's surface texture while removing the microscope frame.

2 Analysis of Results

Each set of images demonstrates key aspects of our segmentation approach:

- **Original Images:**

  - High-quality SEM micrographs showing specimen features
  - Contain microscope frame and scale information
  - Acquired at consistent working distance and voltage

- **Segmented Inner Shape:**
  - Maintains original texture and surface details
  - Removes microscope frame and artifacts
  - Enhances visibility of key features

- **Enhanced Mask:**
  - Provides clear binary separation
  - Shows precise boundary definition
  - Enables accurate region isolation

2.1 Core Libraries

The implementation relies on three primary libraries:

- **OpenCV (cv2):** Primary computer vision operations
- **NumPy:** Array operations and numerical processing
- **Matplotlib:** Visualization and result presentation

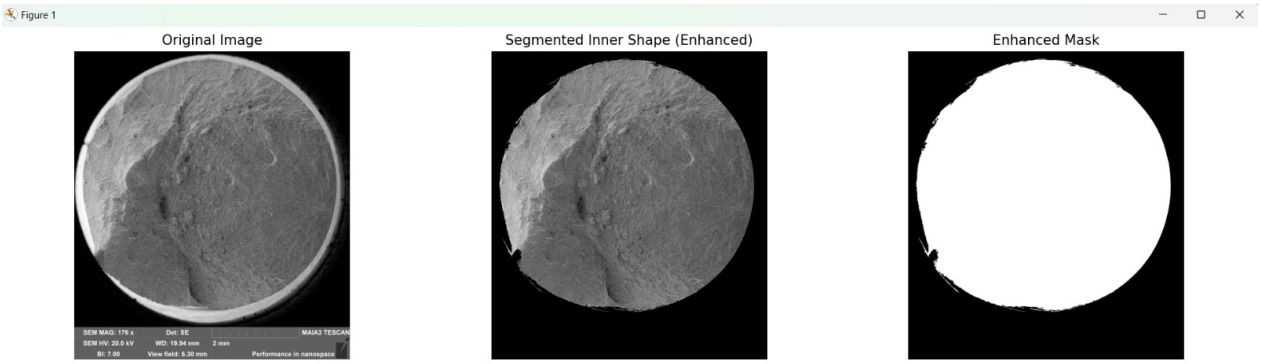

Figure 2: Third specimen analysis demonstrating consistent segmentation performance. The enhanced mask effectively isolates the region of interest while preserving critical surface features in the segmented result.

2.2 Key Functions

The implementation is structured around two main functions:

- `enhance_inner_shape_segmentation`: Core processing pipeline
- `process_and_display_segmentation`: Result visualization

3 Analysis and Discussion

3.1 Key Achievements

Our implementation has achieved several significant outcomes:

- **Feature Preservation:** Successful retention of fine surface details and textures
- **Robust Segmentation:** Consistent performance across different samples
- **Clean Mask Generation:** Precise boundary definition with minimal artifacts
- **Artifact Removal:** Effective elimination of microscope frame and annotations