

# SEM contour extraction application on contact edge roughness

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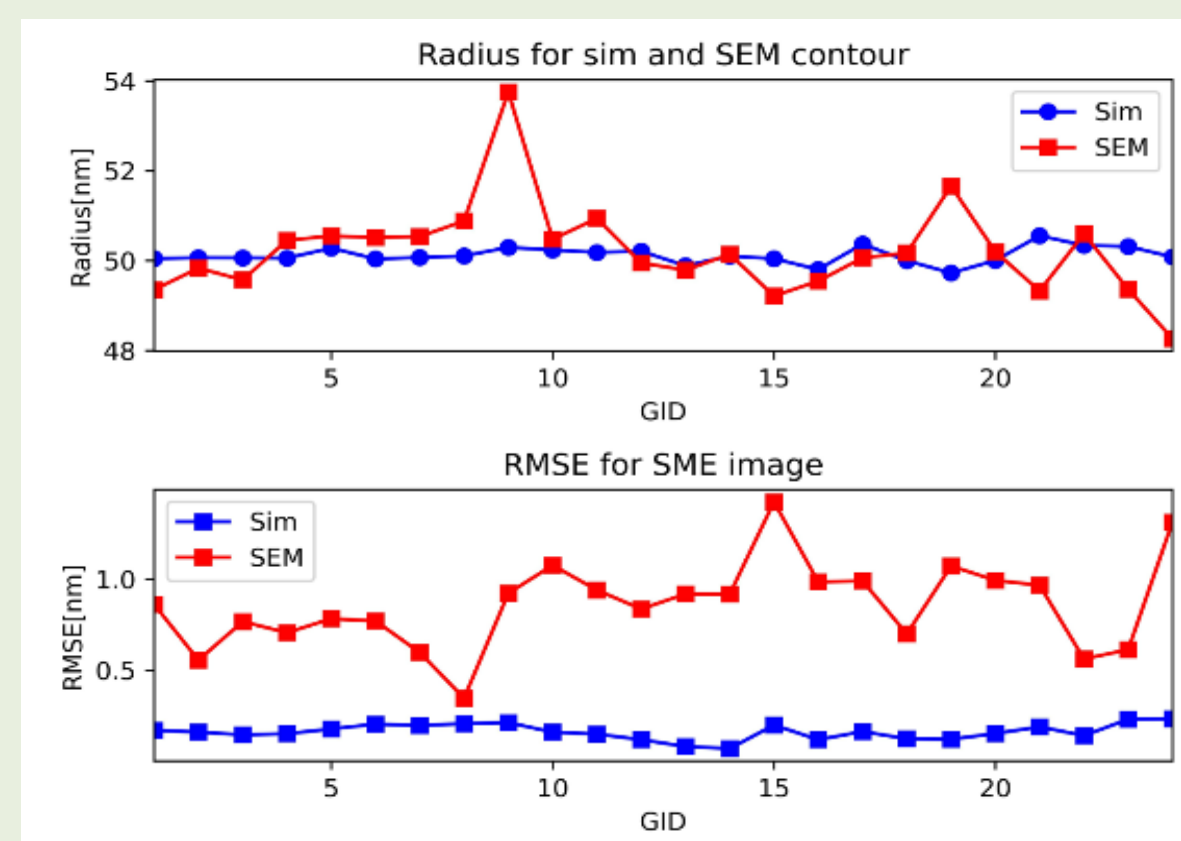


## INTRODUCTION

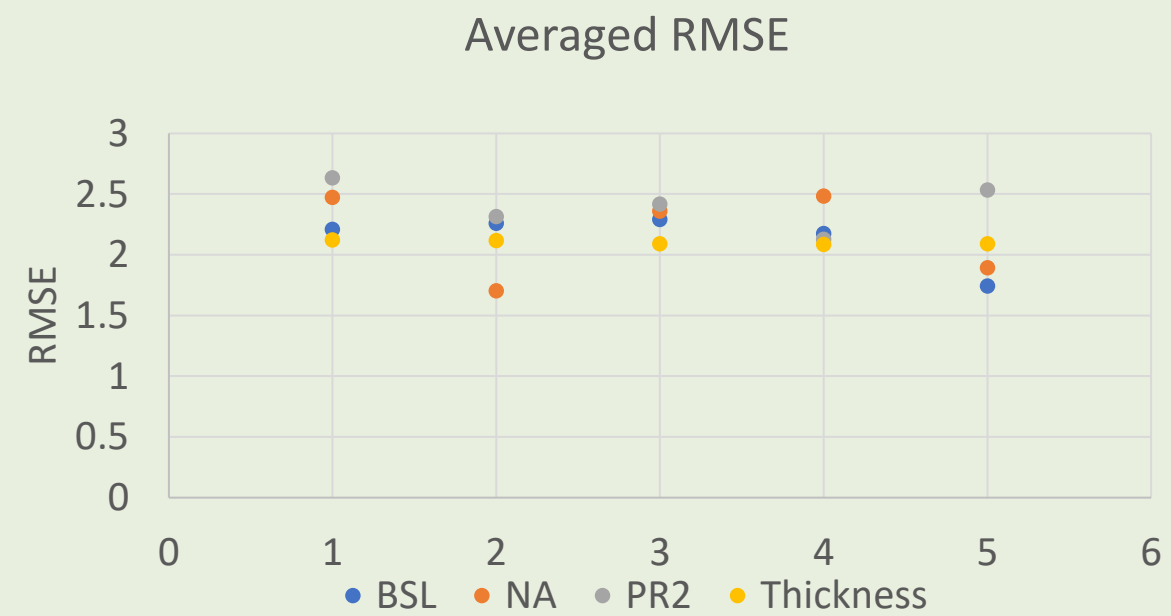
- Calibre SEMSuite™ for contour extraction – Versatile , Reliable & High accuracy;
- Extract the accurate contours from SEM images and couple it with GDS layout, gauge file to explore all kinds of different qualities reliably and promptly instead of CD only.
- Use contour to calculate different properties on contact hole patterns including radius and roughness to find out best optical and resist setting

## RESULTS

Average radius and RMSE with patterns from dense to iso with extracted contour (Red) and simulated contour (Blue) shows which pitch is the weakest

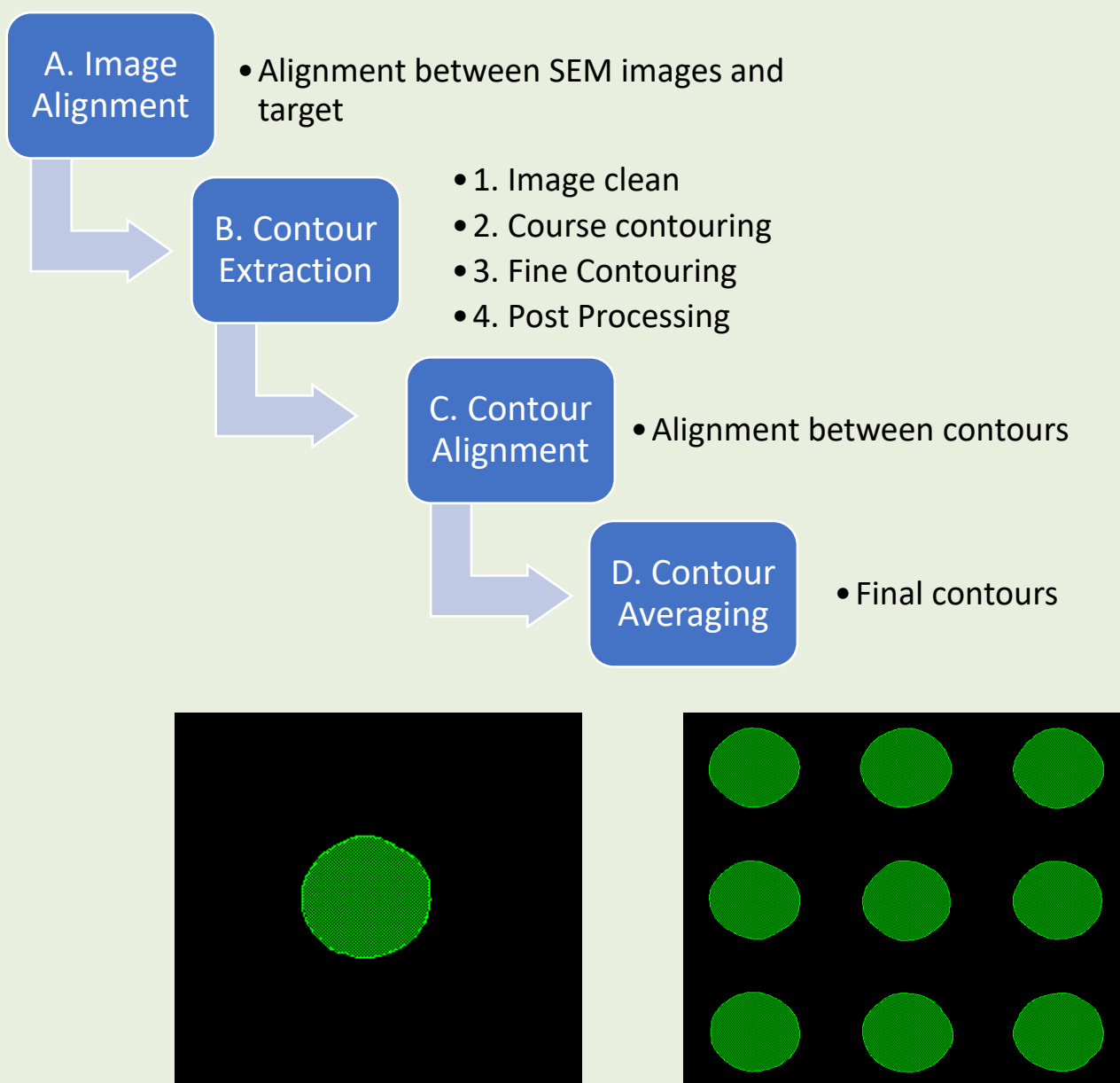


The increment of PR thickness slightly improves RMSE on all five patterns compare to baseline. Other changes such as NA and photoresist component don't show significant difference in contrast to baseline.



Impact on RMSE with different settings on five typical patterns after averaging 5 SEMs.

## CONTOUR EXTRACTION

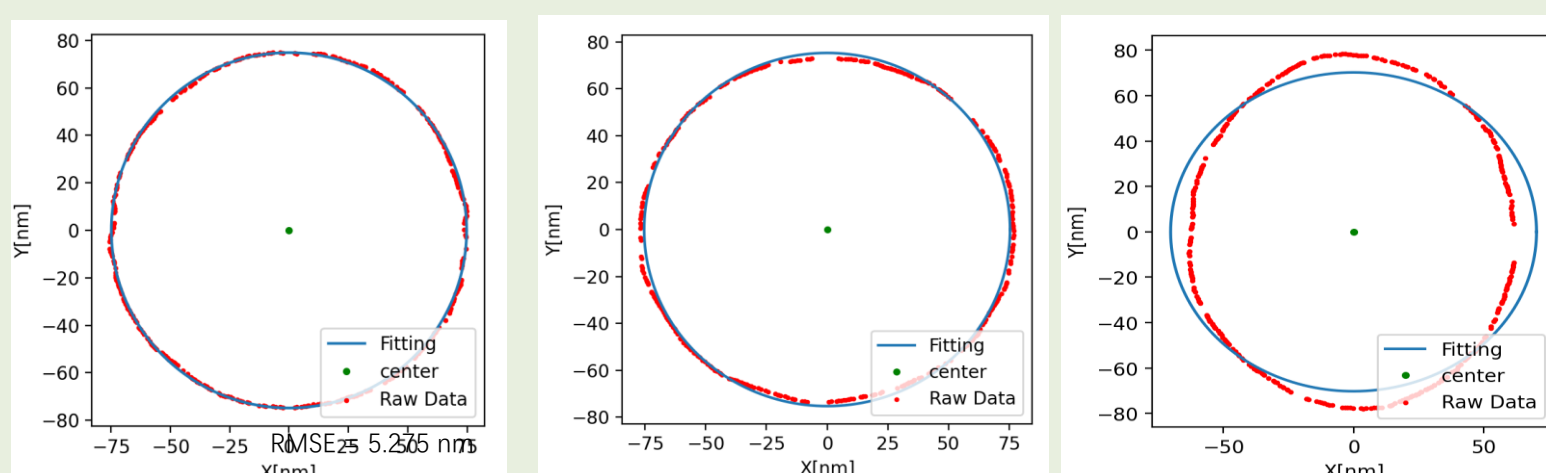


Contour extraction result with iso and dense hole pattern. Green circle is the average result of five contours

## EXPERIMENTAL SETUP

$$RMSE = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (r_i - r_0)^2}$$

$r_0$  and  $r_i$  are the radius of fitted circle and extracted contours, respectively.  $N$  is the number of datasets. With this methodology



RMSE value of 0.598nm, 1.378nm and 5.275nm representing the shape of contact hole from nearly perfect circle to an ellipse

## CONCLUSION

- SEM image contours can provide more information than CD measurements;
- Calibre SEMSuite™ proved to be a robust tool and can extract more information compared to traditional CER measurement method, providing a versatile usage on SEM images.
- Changes on NA and photoresist component don't show significant difference while increasing the thickness of photoresist can slightly reduce the roughness.

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