

# Automated morphologic classification of benign and malignant breast masses on ultrasound

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## Summary of Study

### Purpose:

Differentiate between benign and malignant breast masses on ultrasound using the quantitative measurements of: **circularity**, **solidity**, and **extent**.

### Methods:

- Utilized an existing previously published and publicly available dataset of breast ultrasound images
- Utilized Python and scikit-image for analysis and image processing
- Performed t-test and machine-learning analysis to compare the circularity, solidity, and extent of benign versus malignant masses

### Discussion:

This study demonstrated the utility of the automated calculation for the classification of benign and malignant masses, particularly solidity, which was shown to be a highly sensitive and specific tool for the detection of malignancy.

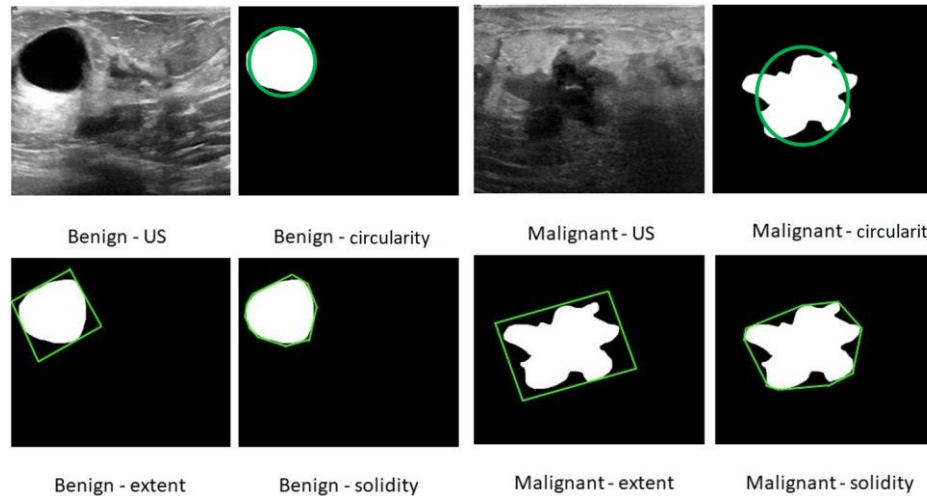
## Defining Study Parameters

*Defining circularity, solidity, and extent:*

**Circularity** =  $\frac{4\pi A}{p^2}$  (similarity to a circle of equal perimeter, with spiculation/irregular margins decreasing circularity)

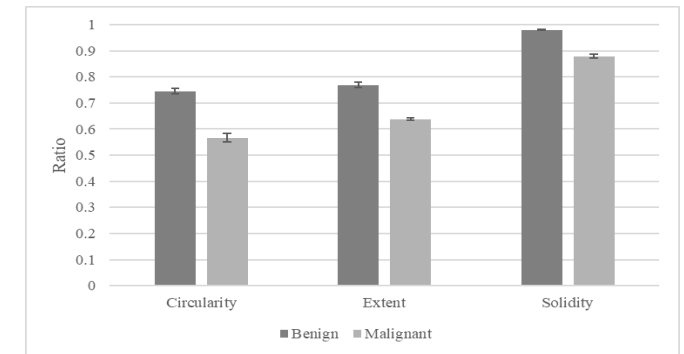
**Extent** = Area of region/Area of bounding box

**Solidity** = Area of region/Area of convex hull



## Results:

**Figure 1.** 665 total breast masses, 454 benign, 211 malignant; p values <<< .001.



**Table 1.** Results of machine-learning classification

Criterion	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)
<b>Circularity &gt; 0.762</b>	96.64	55.38	97.22	55.38
<b>Circularity &gt; 0.827</b>	100	24.37	100	38.40
<b>Extent &gt; 0.693</b>	75.50	93.95	88.86	85.71
<b>Extent &gt; 0.764</b>	98.68	60.83	98.96	54.78
<b>Solidity &gt; 0.971</b>	100	90.19	100	82.78

### References:

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 Romeo V, Cuocolo R, Apolito R, et al. Clinical value of radiomics and machine learning in breast ultrasound: a multicenter study for differential diagnosis of benign and malignant lesions. Eur Radiol. 2021;31(12):9511-9519. doi:10.1007/s00330-021-08009-2