



1.0 Introduction

- Image segmentation
 - Image analysis which seeks to simplify the data into basic component elements or objects

- Foetus segmentation
 - Segment the body of the foetus from the ultrasound image
 - Helps obstetrician for future calculation of the foetus length



2.0 Objective

- The purpose of this paper is to present a segmentation technique using level set method to segment foetus body from ultrasound image. This method helps to solve the issue where the foetus is always changing in shape.
- Level set contour evolved well for the segmentation where the ultrasound image is generally low in contrast and consists noise.



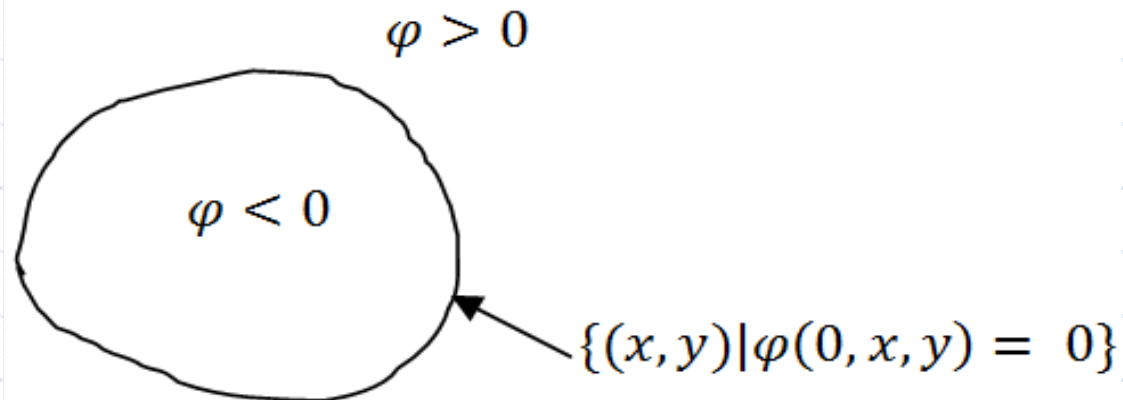
3.0 Methodology

- Variational level set algorithm
 - Active contour:

$$\Gamma(t) = \{(x, y) \mid \varphi(t, x, y) = 0\}$$

- Level set equation:

$$\frac{\partial \varphi}{\partial t} + F \mid \nabla \varphi \mid = 0$$





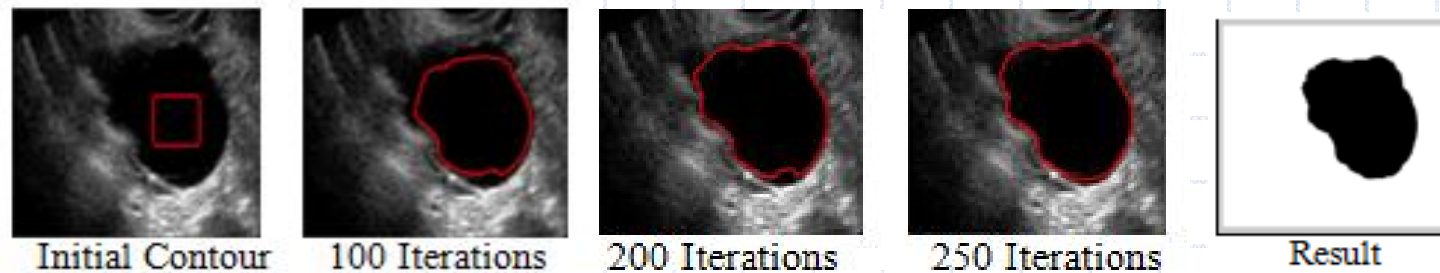
3.0 Methodology

- Ordinary level set function
 - Develop very sharp or flat shape that can cause inaccuracy to the further computation.
 - Re-initialise the function ϕ to be a signed distance function periodically during the evolution is required.
- Variational level set method completely eliminates the re-initialisation procedure.



4.0 Experimental Results

- Performance of Variational Level Set Algorithm on ultrasound image



Evolution level set on ultrasound image of carotid artery



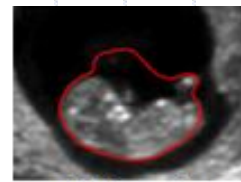
4.0 Experimental Results



Initial Contour



30 Iterations



90 Iterations

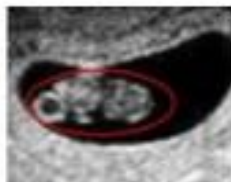


180 Iterations

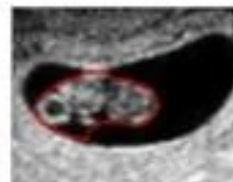


300 Iterations

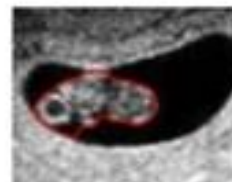
Week tenth fetus



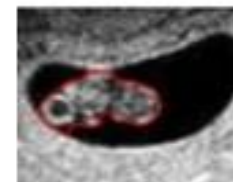
Initial Contour



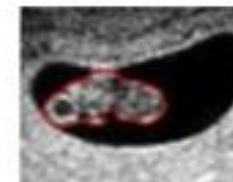
100 Iterations



200 Iterations



300 Iterations

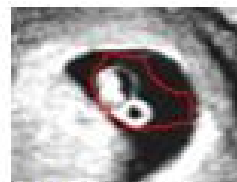


450 Iterations

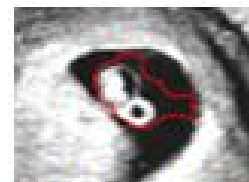
Week eighth fetus



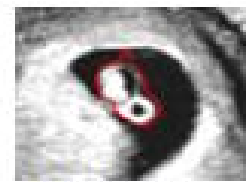
Initial Contour



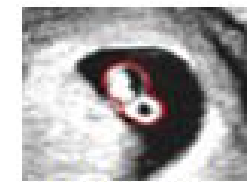
20 Iterations



40 Iterations



80 Iterations






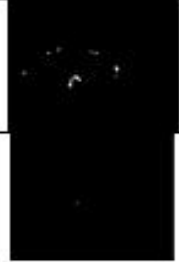





120 Iterations

Week sixth fetus



4.0 Experimental Results

Manually segmentation Result	VLSA Segmentation Result	Difference of manually and VLSA	Percentage Difference
			2.383%
			1.183%
			0.717%

- Percentage differences between the Variational Level Set Algorithm segmentation result and the manually segmented result are small.
- The Variational Level Set Algorithm is suitable to be implemented in foetus ultrasound image segmentation



5.0 Conclusions

- The variational level set algorithm can be successfully implemented in ultrasound image.
- Level set contour evolved well on ultrasound image which is well known for its low contrast and noise.
- Flexible to implement it in various object (foetus) shape without the initial knowledge of the object shape.