assimilated as a fast-marching procedure [114], a type of LevelSet where the direction of the contour propagation remains constant. Therefore, adding more details of our previous work is used here to illustrate some of the inconveniences reported in table 3.1 when using these methodologies applied to breast lesion segmentation in US images and how this limitations are commonly overcome using our work as illustration case.

3.2 GCS-based segmentation

When applying GCS or ACM to segment breast lesion US images with no user interaction, common strategies to overcome their limitations arise. The main inconveniences are:

- the need of an accurate initialization.
- the lack of a manipulable data model to introduce high level features for the contour to evolve.

The need of an accurate initialization is overcome mainly by generating a preliminary segmentation usually using ML procedures [60], [81]. The use of ML allows us to take advantage of high level features to localize the lesions but, most of the time, there is no need to introducing high level features within the contour evolution when the initialization is close enough to the solution. A practical way to introduce high level features into the evolution of the ACM consists of generating an image from those high level features and let the ACM evolve in the synthesized image [68].

In our GCS-based segmentation proposal, both strategies, generating a preliminary segmentation taking advantage of ML, and letting the segmentation evolve on a synthesized image, are used to perform the segmentation.

3.2.1 General outline of the GCS-based segmentation framework

Figure 3.1 shows the basic operations for the proposed GCS-based segmentation framework: after an initial region $R_0(x, y)$ is determined, it is converted into a preliminary lesion delineation $R(x, y)$ by means of a region growing algorithm. This lesion delineation is used to obtain a multivariate Gaussian function describing the shape, position and orientation of the lesion ($G_{\mu\Sigma}(x, y)$). Finally, the Gaussian Constraining Segmentation (GCS) procedure refines the segmentation by thresholding an intensity dependent