Abstract—We have proposed a three dimensional model of scatterer distribution in diseased liver. This technique enables us to obtain various B-mode images of fibrous liver considering tissue acoustic structure. We were able to get the simulated ultrasonic image in which was reflected the three dimensional tissue structure. Using the B-mode images which are obtained from these scatterer distributions, we analyze the relationship between the changes in biological tissue and the B-mode images during progressive liver cirrhosis.

I. INTRODUCTION

The realization of quantitative diagnosis is strongly required in the clinical field. In order to establish “quantitative diagnostic ultrasound”, we have been developing a quantitative estimation technique for liver diseases using ultrasonic echo data. For quantitative diagnosis it is important to examine the relationship between ultrasonic B-mode image and liver tissue. However it is difficult to observe continuous stage of liver disease clinically, especially the beginning stage. We proposed a scatterer distribution model of diseased livers considering the liver lobule structure, because computer simulations are effective for obtaining information on the continuous stage of diseases. We examine relationship between tissue characterization and ultrasonic B-mode image which is simulated by a scatterer distribution model.

II. TECHNIQUE OF MODELING FIBROUS LIVERS

Liver tissue structural change is simulated as follows. 1) Central point position of each lobule is defined in three-dimensional space. 2) Inflammatory properties are given to central points that randomly selected at a certain rate. 3) Combine the adjoining central points with inflammatory properties. 4) Central points are relocated considering adjoining center point. Inflammatory properties are cleared. The procedures 2), 3), 4) are repeated to express the progression of the disease.

Scatterers are distributed to the 3D space as follows. 1) Calculate each position potential distribution. 2) Define boundary using potential distribution value. 3) Classify tissues according to states such as fiber, lobule and nodule. 4) Distribute scatterers. We simulated scatterer distribution using proposed simulation model of fibrotic liver. Then we calculated the B-mode images using the structures of scatterers. Using this simulation tool, we have been developing a quantitative diagnosis technique.

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Figure 1. Procedure of distributing scatterer

III. CONCLUSION

We have presented a modeling technique for various fibrous livers considering the liver lobule structure and the progression of the nodular structure. This technique enables us to obtain various B-mode images of fibrous liver considering tissue acoustic structure. We will examine relationship between tissue structure and simulated B-mode image to develop quantitative diagnosis methods.

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