Roughly Extracted Line Extraction from the Vector Field

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1 Introduction

The visualization of the flow field is being used as the method to analyze a result of numerical simulation of the fluid in the field such as fluid dynamics, aviation dynamics. It is the important subject of the visualization method to make a person grasp the behavior of the flow field. The visualization of the 2-D flow field by the arrow and the stream line is one of the typical methods, and can grasp the behavior of the flow field intuitively. For this reason the visualization method which made this method develop has been researched widely. Furthermore, the visualization method of the 3-D flow field with volume rendering has been researched.

Most of existing methods are capable of visualizing the flow field which the amount of data is small in. However, it is not effective when the whole of the flow field which visualization range is wide is visualized with these methods, because information of the flow field is indicated in large quantities, and grasping the flow field is difficult. On the other hand, when it thought about a result of visualization with the approximation of the flow field, it is lower approximation level to restrict the amount of indication. Therefore, there are relations of trade off between the approximation and the amount of indication.

To cope with this problem, it is proposed as an application that a interactive visualization method is called AVS. The feature of this method is that a user can control the amount of indication. This method is effective for problem about trade off of the approximation and the amount of indication. However,there are following problems: (1) A result of visualization varies in the user. (2) It is difficult to estimate for result of the visualization. To resolve these problems, it can think about visualization method which

balance of the approximation and the amount of indication is decided with some objective criterion for evaluation.

In this paper, we proposed a novel visualization method for the vector field (e.g. flow field, magnetic field). In the proposed method, it thinks that whole of the vector field is visualized by the roughly extracted line, the decision of a balance with the approximation and the amount of indication by using information criterion, and a roughly extracted line is extracted from the vector field.

2 Region segmentation of the vector field

In proposed method, to acquire a roughly extracted line which reflected the vector field, in the proposed method, to acquire an roughly extracted line which reflected the vector field, it first gets a class and a class boundary that reflected the vector field by the region segmentation of the vector field.

The region segmentation of the vector field is doing by the deciding both of the number of classes and the class boundary by ISODATA that AIC was introduced as a objective criterion. This method does the region segmentation which decide the number of classes by maximizing likelihood of each class by using k-means, and decide a class boundary by estimating the best region segmentation model by using AIC.

The region segmentation model is shown in the total peace of log-likelihood and free parameter of each class by using AIC which the data of each class are assumed to be subject to the multivariate normal distribution. The estimate of the region segmentation model acquire the best region segmentation model by iterating k-means and split (or merger) of the class until the decrease of AIC is converged.

The split (merger) of the class is done when AIC decrease (increase) by split or merger of the class. The merger process does toward the class pair that a distance between the average vector of each class becomes the smallest in the data space. The split process first calculate feature value of data on the class which variance of the class is the largest, and the split of the class is done by splitting data into two in the feature value space. A split point in the feature value space use the pint that variance between the classes becomes the largest.

3 Generation of the roughly extracted line

The roughly extracted line which reflected the vector field is formed based on the class and class boundary which could get it more for the region segmentation. In this method, to generate a roughly extracted line of the vector field, a straight line is formed, and an roughly extracted line which center of gravity vector of the class and boundary center of gravity vector was connected is formed by choosing a desirable straight line for roughly extracted line of the vector field.

The center of gravity vector of the class and boundary center of gravity vector first calculate, and acquire straight line which those center of gravity vectors were connected.

It is desirable for the roughly extracted line of vector filed that straight line which has the direction which is close to the direction vector in the center of gravity vector of the class and boundary center of gravity vector. Therefore, it is used for evaluation criteria that an error of the direction vector with straight line and the center of gravity vector of the class and boundary center of gravity vector, and a roughly extracted line is formed by choosing the straight line that an error is small.

4 Experimental result of roughly extracted line extraction from the vector field

We performed the following experiments using result of numerical simulation of the fluid to verify the proposed method. (1)The roughly extracted line extraction which the flow data were used for. (2)The roughly extracted line extraction which the flow data which uniformed flow velocity were used for. As the result of these experiments, the region segmentation which reflected the vector field was acquired by estimating the best region segmentation model with AIC, and it could be extracted favorably though the roughly extracted line of the vector field was partial by using center of gravity vectors of the class and boundary center of gravity vectors. This shows the effectiveness of the proposed method that information criterion was introduced.

5 Conclusion

In this paper, we proposed a novel extraction method for the vector field by using the objective evaluation with information criterion. The roughly extracted line which reflected the vector field could be extracted in the experiment which result of numerical simulation of the fluid was used for by using the proposed method that information criterion was introduced. It responded to the purpose from the difference in two extraction experiment results, and it could be confirm that you had only to take the magnitude of the vector into consideration. Further works are listed as following: (1)The choice method of the center of gravity vector by using the same criterion as AIC. (2)The extraction method which introduced the time step of the vector data.