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Article / Book Information

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種別(和文)	論文要旨
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（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	Nuclear Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 (Engineering) Doctor of
学生氏名： Student's Name	Treenuson Weerachon	指導教員（主）： Academic Advisor(main)	Kikura Hiroshige
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis presents a study on the accurate flowrate measurement using ultrasonic velocity profile (UVP) method for the complicated flow as downstream of the double bent pipe especially in case of large pipe. In additions, because the flow downstream of double bent pipe is nonsymmetrical, the estimating of the number of measurement lines to accurate flowrate measurement with UVP is necessary. Moreover, the length of measurable point where is downstream of double bent pipe is optimized to avoid the effect of secondary flow. In this study, the estimating number of measurement lines applied to the conditions of circulation water loop system in nuclear power plant.

Chapter 2. The characteristic of the ultrasound was effect on the accurate flowrate measurement especially in case of large pipe. The setup angle for optimal transmission of the ultrasound and optimal spreading angle of ultrasound beam are important for the experimental setup. In this case, minimizing of the setup angle is necessary. In addition, the arrangement of the angle of sensor on the pipe wall can avoid the reflection from the pipe wall. Moreover, the couplant material can be used to reduce the reflection of the sound wall from the propagation of transducer. The water box which water can cover the pipe wall as the couplant material and it is similar to the fluid flow in pipe. From this usage the refraction angle at couplant material and refraction angle at fluid flow are same follow from Snall's law.

Chapter 3. Flow rate in the transient conditions downstream of double 90º bent was measured to investigate the accuracy of the flow rate measurement using this multi-lines method. Many ultrasonic transducers can be used when more accurate flowrate is desired or the flow is asymmetric flow. When flowrate near the bent pipe is measured by UVP method, many measurement lines are necessary to make two- or three-dimensional velocity profile mapping due to its asymmetric flow. Then Flowrate can be calculated using multiple velocity profiles for circumferential interpolation.

Chapter 4. The experiment results can compare and confirm with theoretical method. The numerical calculation setup the circular positions measurement lines on the wall surface same in the experiment conditions. The turbulent model and the wall function in Computational Fluid Dynamics (CFD) were considered. The number of data should sufficient to plot the velocity profile precisely. For this reason, the number of mesh should be considered. It can confirm both experimental and numerical results.

Chapter 5. The estimation of the number of measurement lines using a new analytical method for double bent pipe. Fourier analysis is a mathematical method used to transform a periodic function. It has been applied to a wider variety of problems in the physical and natural sciences. Then, in this study, it was applied to estimate the largest number of waves, and necessary numbers of measurement lines for each position are indicated analytically by using sampling rate theorem. To apply the theorem to this kind of measurement by UVP method, the velocity profiles on the radial measurement lines must be converted into circumferential profile(s). Therefore, multiple measurements changing circular angle by 10 degree were examined and observed profiles on line were accumulated for conversion into circumferential velocity profiles on concentric circles. Every velocity profile shows the wave form as come in the form of harmonic wave that the horizontal axis means was compared and represented in time-series data the transducer circular position of transducer around the pipe wall, while the vertical axis means the time-averaged velocity normalized by the mean velocity was compared to the amplitude of the harmonic wave. From each harmonic wave, we can verify the circumferential position where peaks of waves occur. Then, it is simply to set the position of measurement lines at the peaks of wave both maximum and minimum positions. Fast Fourier Transform (FFT) method changed the waveform data to frequency data in the case of analog signal data. Circumferential velocity profiles were changed to frequency data each. Then, the Nyquist's theory estimated the number of measurement lines.

Chapter 6. Flow downstream of double bent pipe is nonsymmetrical flow. Using UVP, it needs to find out the number of measurement line for accurate flowrate. However, necessary number of sensors can be calculated analytically by regarding velocity profiles as a kind of wave. Sampling rate theorem for waves can indicate the necessary number of the sensors. In additions, the application of this method can be applied in this chapter in case of circulation water loop system in nuclear power plant as the similar conditions for instance, the out-of-plane angle of the double bent pipe, the distance between first bent and second bent pipe, Reynolds number and so on. From the results of this method, this study can apply the estimating method for the number of measurement lines using UVP method.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).