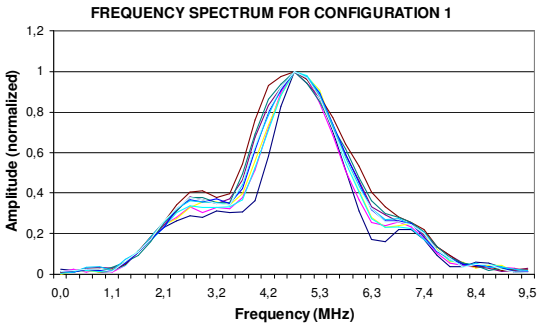
Determination of size distribution of bubbles in a bubbly column two-phase flows by ultrasound and neural networks

D. B. Baroni[1], J. S. C. Filho[2], M. S. Q. Bittencourt[1], C. M. N. A. Pereira[1], M. S. Motta[3]
e-mail: douglas@ien.gov.br

[1] *Division of Nuclear Engineering - IEN*
[2] *FAETEC/RJ*
[3] *CEFET/RJ*

Keywords: ultrasound; neural network; frequency spectrum

The development of advanced nuclear reactor conceptions depends largely on the amount of available data to the designer. Non invasive ultrasonic techniques can contribute to the evaluation of gas-liquid two-phase regimes in the nuclear thermo-hydraulic circuits. A key-point for the success of those techniques is the interpretation of the ultrasonic signal [1-4]. In this work, a methodology based on artificial neural networks (ANN) is proposed to predict size distribution of bubbles in a bubbly flow. To accomplish that, an air feed system control was used to obtain specific bubbly flows in an experimental system utilizing a Plexiglas vertical bubbly column. Four different size distribution of bubbles were generated. The bubbles were photographed and measured. To evaluate the different size distribution of bubbles it was used the ultrasonic reflected echo on the opposite wall of the column. Then, an ANN has been developed for predicting size distribution of bubbles by using the frequency spectra of the ultrasonic signal as input (Figure 1). A trained artificial neural network using ultrasonic signal in the frequency domain can evaluate with a good precision of the size distribution of bubbles generated in this system.



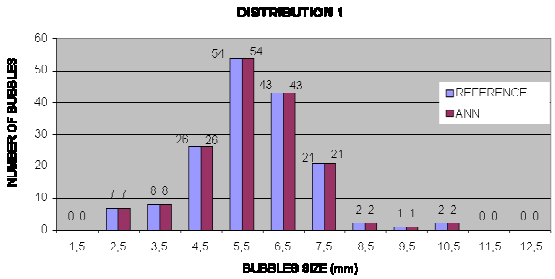


Figure 1 - Frequency spectrum and bubbles distribution for configuration 1.

References

[1] Cunha Filho, J. S.; Baroni, D. B.; Lamy, C. A. ; Pereira, C. M. N. A ; Bittencourt, M. S.Q. ; Motta, M. S. ; Su, J, "*Neural Network to Measure Volumetric Fraction of a Bubbly Column using Ultrasonic Wave*", 20th International Congress of Mechanical Engineering -COBEM 2009.

[2] Baroni, D. B. ; Bittencourt, M. S. Q.; PEREIRA, C. M. N. A., "*Analysis of Ceramic Pellets Using Ultrasound: Time of Flight and Frequency Spectrum With Neural Network*". In: International Nuclear Atlantic Conference - INAC 2009.

[3] Costa, A. M. L.; Baroni, D. B.; Bittencourt, M. S. Q. ; Lucas, C. S, "*Ultrasonic Analysis of Sintered Alumina Pellets*" In: International Nuclear Atlantic Conference - INAC 2009

[4] Faccini, J. L. H.; Su J.; Harvel G. D. and Chang J. S., "*An advanced ultrasonic technique for flow and void fraction measurements of two-phase flow*", Proceedings of ICONE12:12th International Conference On Nuclear Engineering, 2004, Virginia, USA.