Investigation of signal characteristics of airborne ultrasounds for obtaining detailed information in abnormality detection

Wan-Ho Cho[1], Jiho Chang[1], Ookjin Jung[2], Agustinus Oey[3], Yong-Hyun Kim[2], Inkwon Kim[2], Youngkey Kim[2]

[1]Division of Physical Metrology, Korea Research Institute of Standards and Science, Republic of Korea, [1]-, SM Instruments, Republic of Korea, [1]-, VizWave, Indonesia

Ultrasound-based abnormality detection is non-contact method and has advantage that is able to measure from a relatively distant location with portable equipment, so their use has recently been increasing. Conventionally, resonant type transducers have been applied for this purpose to enhance the signal to noise ratio. Recently, this diagnostic technology has been combined with array-based sound source localization techniques, making it possible to not only estimate the location of occurrence but also improve the signal through spatial filtering, and possible to ensure a sufficient signal-to-noise ratio even with a broadband sensor such as a microphone. This means that the signal characteristics of a wide frequency band can be used for diagnosis, and can be expanded from simply identifying the presence or absence of an abnormality to identifying the type and degree of the abnormality. In this study, acoustic signals induced by gas leakages and partial discharges were measured and detailed time and frequency characteristics were observed. For this purpose, the simulating devices to make leakage and partial discharge were designed. It can be seen that the signal in frequency band of interest increases dramatically through spatial and high pass filtering. In addition, it was confirmed that a good decision is made in the machine learning-based model using a spectrogram based on STFT to classify the types of abnormality. In this way, it is expected that more various information related to the detailed condition of abnormality can be determined by broadband measurement results of the airborne ultrasonic band.