Rib suppression aids pulmonary nodule detection

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The evaluation of a combination of rib-suppressed and original chest radiographs significantly improved the diagnostic performance of radiologists in the detection of pulmonary nodules, according to an observer study published this month in the *American Journal of Roentgenology*.

A team from the departments of radiology at the University of Chicago and the University of Kumamoto in Kumamoto, Japan, developed a massive-training artificial neural network (ANN)--a nonlinear pattern recognition tool that has been used in computer-aided diagnosis applications--to suppress rib opacity on chest radiographs while maintaining soft-tissue contrast.

“With this technique, soft-tissue and bone images can be generated from a single chest image obtained with standard radiographic methods,” the authors wrote.

In research designed to determine the usefulness of the massive-training ANN tool, the development team investigated the clinical efficacy of rib suppression in the detection of pulmonary nodules smaller than 20 mm on chest radiographs.

The group first trained the massive-training ANN with five sets of chest radiographs: four cases with nodules and one without. Only cases where at least 20 percent of the nodule area was overlapped by ribs were selected.

“An important property of the massive-training ANN is its ability to be trained with a very small number of cases,” the authors noted.

The application then was able to output a bone-image-like image on which the bones were isolated and enhanced, as well as a soft tissue-image-like image on which ribs were suppressed, from a single chest image obtained with a standard radiographic system.

For the observer performance portion of the investigation, 60 chest radiographs were chosen from the Japanese Standard Digital Image Database, developed by the Japanese Society of Radiologic Technology. Seven board-certified radiologists and five radiology residents participated in this part of the study.

The 60 patients sampled were comprised of 36 men and 24 women with a mean age of 59.4 years. The radiographs represented two groups of images-- 30 patients with only one malignant solid pulmonary nodule not larger than 20 mm without calcification and 30 patients without nodules. The mean diameter of the pulmonary nodules was 14.7 mm.

The researchers reported that six of the 30 nodules completely overlapped bone shadows of the ribs or a clavicle, 17 overlapped partially, and seven did not overlap on chest radiographs.

For all 12 observers, the mean values of the area under the best-fit receiver operating characteristic curve for images without and with rib suppression were 0.816 ± 0.077 and 0.843 ± 0.074; the difference was statistically significant. The mean areas under the curve for images without and with rib suppression were 0.848 ± 0.059 and 0.883 ± 0.050 for the seven board-certified radiologists and 0.770 ± 0.081 and 0.788 ± 0.074 for the five radiology residents.

“We found that when board certified radiologists evaluated a combination of rib suppressed images and

no specialized equipment for generating dual-energy x-ray exposures because only software is needed," they wrote. "There also is no increase in radiation dose exposure because chest radiographs acquired with standard radiographic systems are used."

The developers did recognize that the effectiveness of their application needs to be compared with dual-energy subtraction chest radiography in further investigations. However, the team is encouraged with the success of its system so far.

"Our results suggested that the rib suppression technique helps skilled radiologists in the detection of relatively small pulmonary nodules," they wrote. "We strongly suggest that use of this technique has potential for reducing the number of lung nodules missed in routine clinical practice."

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