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**Development of Quantitative Methods for Assessment of
Ventilation-Perfusion Ratio in the Human lung using Magnetic
Resonance Imaging**

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The V/Q-ratio is a clinically important physiological parameter describing the relationship between lung ventilation and perfusion. It is usually measured using scintigraphy imaging, but the radiation and lack of quantitative numbers limits this method. A non-ionizing quantitative V/Q imaging method would therefore be preferable. In this work, novel quantification techniques for ventilation, perfusion, and the V/Q-ratio are demonstrated in both healthy volunteers and patients using MRI.

This is done using the Fourier Decomposition method, which was developed as a non-invasive method for assessing ventilation and perfusion in the lungs using MRI. However, it only records relative values, making intra-patient studies and follow-ups difficult. The method is further developed by extracting baselines from within the images themselves, and quantification of the values is thus possible. For the perfusion, a region assumed to consist of 100% blood is utilized, while for the ventilation the zero-frequency component is used. A study with ten healthy volunteers and nineteen patients diagnosed with lung cancer was performed to evaluate the two methods and compare with other published methods.

The quantified ventilation, perfusion and V/Q images are all in agreement with other published methods and were shown to have values with the expected spatial distribution and in the correct physiological range. The images from the patients also show all the expected defects, both in ventilation and perfusion, as well as in the combined V/Q-map. A statistically significant ($p < 0.05$) lower ventilation was found in the afflicted lung compared to the non-afflicted in the cancer patients, but no statistically significant difference between the lungs was found for the perfusion or V/Q-ratio. Unrealistic values and suspected artifacts could be seen in several of the patient images, raising questions about the robustness of the method when applied to patients.

In conclusion, non-invasive, quantitative V/Q-imaging is possible using MRI. The method requires only a single acquisition of less than 30 seconds, but robustness in patients remains an issue.