Multi-frequency apparent conductivity distribution for ion mobility imaging in electrical impedance tomography

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Abstract. In living tissues, some ions such as sodium and potassium are charge carriers in a conducting medium. The ionic current flows extensively throughout both intracellular and extracellular volumes. The conductivity of each tissues and organs inside a body is varied differently in the frequency domain due to ion selective semipermeable membranes and anisotropic properties of tissues mainly. It is also affected by the temperature, and the concentration and mobility of ions. Electrical impedance tomography produces an image for the conductivity distribution from externally injected currents and induced voltages. We need to understand the apparent conductivity from the ion mobility and membrane characteristics. We built several conductivity phantoms with a solid metal, an acrylic cylinder, biomaterials (carrot and potato), and a hollow insulating cylinder with holes. Filling both inside and outside the hollow cylinder with the same saline, we controlled ion mobilities to create a conductivity contrast without being affected by the ion diffusion process. From the phantom experiments, we could validate the contrast conductivity spectrum with several testing objects using EIT. Interpreting reconstructed apparent conductivity images of the phantom as ion mobility imaging method, we discuss the meaning of the apparent conductivity seen by a certain probing method. From the results, we expect to detect a cancerous tissue within the body consisted of many objects which have different conductivities and its spectrum using frequency difference imaging method.

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