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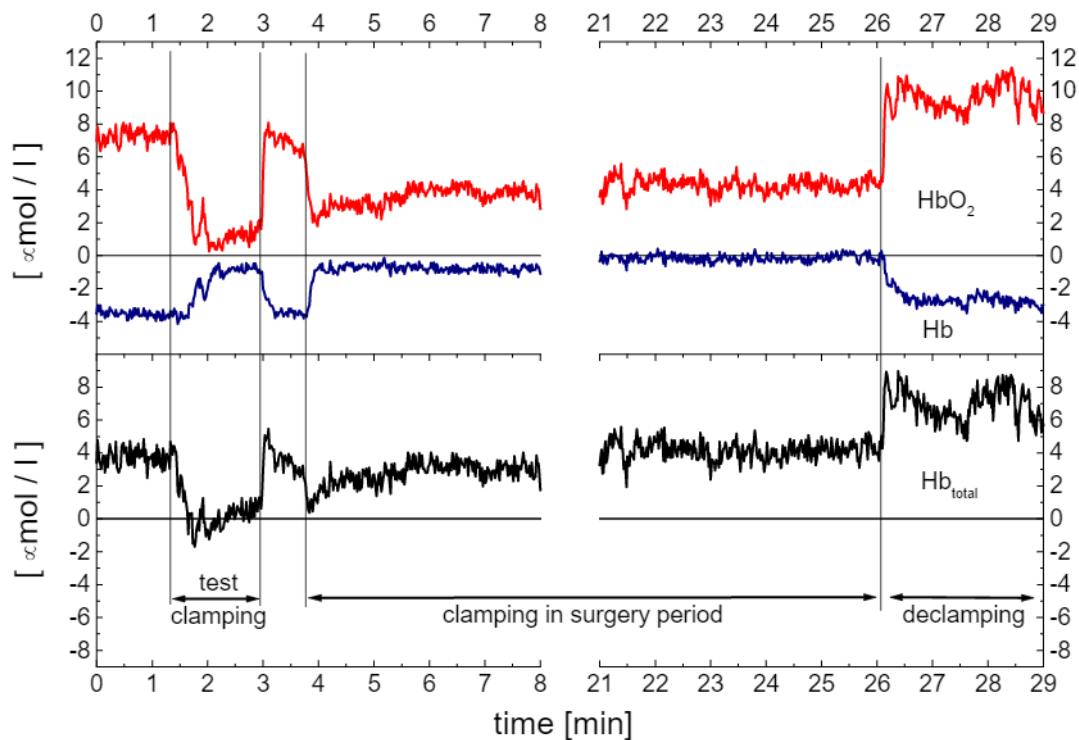


Fig.1. Oxyhaemoglobin (HbO_2), deoxyhaemoglobin (Hb) and total haemoglobin (Hb_{total}) recordings during carotid endarterectomy

Scanning electrical conductivity interfaces by means of ultrasound in magnetic field

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Introduction: The propagation of ultrasound in a conductive medium in the presence of a magnetic field gives rise to a Lorentz force exerted on charge carriers. Since opposites charges are submitted to forces of opposite directions, the resulting effect is the creation of a bulk current density that can be shown proportional to the electric conductivity of the medium [1,2,3]. In the present study; the total current created in an object was collected using large surface electrodes. Specific signal processing enabled the visualisation of conductivity interfaces along the ultrasound path.

Equipment & Methods: A focused transducer generated $6 \mu\text{s}$ duration pulses at 500 kHz with a peak pressure of 1.5 MPa at a repeat frequency of 790 Hz. The magnetic field (350 mT) was created by a purpose-built, U-shaped magnetic circuit comprising NdFeB permanent magnets [4]. The measuring chamber consisted of a rectangular flask of transparent PVC (12 cm long, 4 cm wide and 12 cm high) open on the top. Two opposites sides consisted of ultrasound permeable membranes. The used conducting

models were $2 \times 3 \times 5 \text{ cm}^3$ cuboid blocks of agar gel. The gel was prepared with 9 g/l NaCl saline plus 25 g/l of agar powder. It was verified that the final conductivity of the gel was close to that of the initial saline. The current was collected by means of a pair of 9 cm long and 3 cm wide brass plates, parallel to the ultrasound beam and placed in contact with the upper and lower sides of the gel blocks (Fig.1). The electrodes were connected to a purpose-built dual input current-to-voltage converter (25 mS input admittance, 78000 V/A). The signal was recorded using a 420A Tektronix digital oscilloscope (8-bit, 10 Ms/s, averaging mode: $n=10000$).

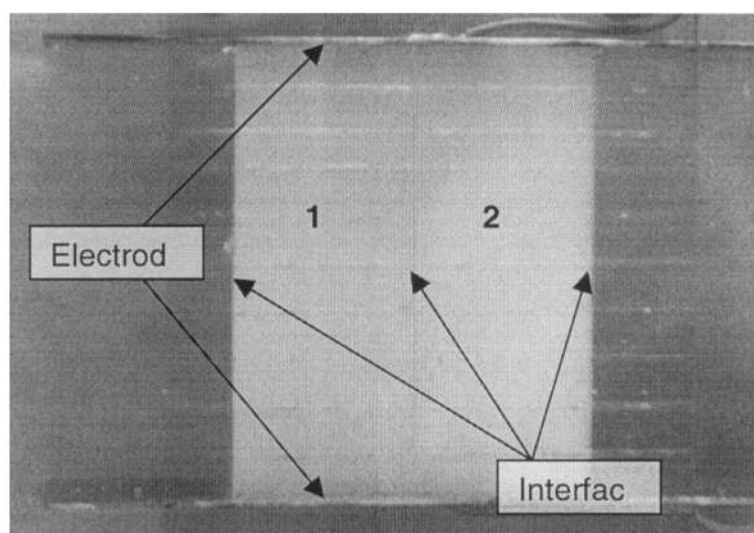


Fig. 1 : Agar model with 2 regions of equal lengths and different conductivity values ($\sigma_1=0.5 \text{ S/m}$, $\sigma_2=1.4 \text{ S/m}$).

Results: The measured signal consisted of bursts at the same frequency as the ultrasound pulses. Inverse filtering was applied to the raw signal to retrieve the 1-D distribution of electrical conductivity gradients along the ultrasound path. Several filtering methods were considered [5]. In the present study, the signal was first windowed using a Blackman filter in the time domain. The spectrum of the windowed signal was then processed using a Wiener filter [5]. The final filtered signal was obtained by inverse fast Fourier transform. The signal shown in Fig. 2 is the response of a gel block comprising two regions of different conductivity values immersed in a non conducting medium. The signal duration shown in Fig. 2 is $600 \mu\text{s}$ ($\approx 9 \text{ cm}$). The interval between pulses was verified equal to the time-of-flight of the sound wave across each region. The 3 peaks observed correspond to the conductivity interfaces separating the 4 regions (0 S/m, 0.5 S/m, 1.4 S/m and 0 S/m).

Discussion: The complete theory shows that the final signal reconstructed according to the above method is proportional to the gradient of σ/ρ along the sound path. However, in the present study, the mass density ρ of the medium was practically constant. One may therefore consider that the signal of Fig. 2 reflected predominantly the changes in the electric conductivity of the medium.

Conclusion: The above results showed the feasibility of scanning electric conductivity interfaces with ultrasound. This method yields a new modality, termed Ultrasonic Lorentz Force Imaging (ULFI) [6] for bio-electrical tissue characterisation and imaging using ultrasound as a probe. Further studies include the

construction of multi-electrode systems and the development of algorithms for 2-D and 3-D image reconstruction.

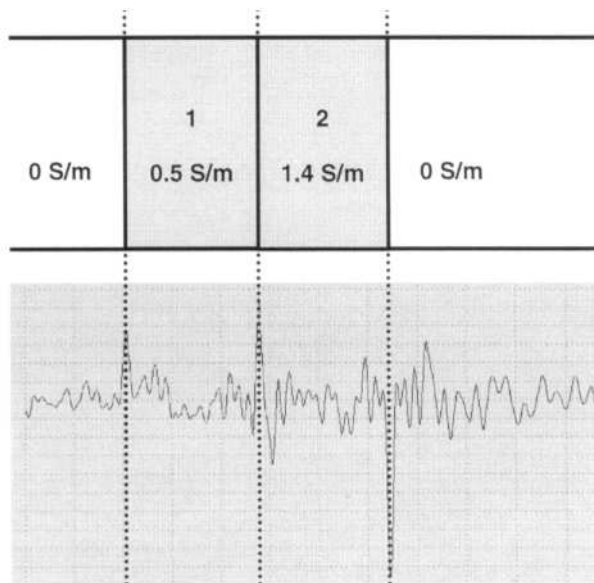


Fig. 2 : Final signal after Wiener filtering showing the conductivity interfaces between regions of different electric conductivities (0, 0.5, 1.4, 0 S/m, arbitrary vertical scale)

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Design of speckle denoising filter using wavelet-based thresholding for medical imaging application

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Summary: One of the most significant features of diagnostic echocardiographic images is to reduce speckle noise and make better image quality. In this paper we proposed a simple and effective filter design for image denoising and contrast enhancement based on multiscale wavelet denoising method.

Wavelet threshold algorithms replace wavelet coefficients with small magnitude by zero and keep or shrink the other coefficients. This is basically a local procedure, since wavelet coefficients characterize