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Novel Multi-Electrode Electromagnetic Flow Meter

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Objective: The novel electromagnetic flow meter includes sixteen electrodes equally spaced around the internal circumference of an 80mm diameter Delrin pipe. In an initial experiment these electrodes are paired according to a-a’, b-b’ etc with the line between each of the 7 electrode pairs lying normal to both the direction of the imposed magnetic field and the fluid direction.

The multi-electrode electromagnetic flow meter shows considerable promise as a means of measuring the local velocity distribution in highly non-uniform single phase flows. Recent work undertaken at University of Huddersfield also shows that the device can be used to measure the local water velocity distribution in multiphase flows.

Future Work:
- To increase the spatial resolution of the measurement form 7 pixels to 120 pixels in the flow cross section.
- To improve the accuracy of the velocity profile obtained from the matrix inversion algorithm.
- Apply the electromagnetic flow meter to measure the water velocity distribution in ‘water continuous’ multiphase flows (e.g. oil-in-water and solids-in-water flows).
- Use the electromagnetic flow meter in conjunction with an EIT system to measure the volumetric flow rates of both phases in two phase flows.
- Investigate electrode material which minimise voltages generated due to electrochemical effects.
- Investigate the effects of dimensional errors in the flow meter on the values of the weight functions.
- Investigate alternative matrix inversion methods such as the conjugate gradients method.

Weight Function Theory and Pixel Separation Method:

The weight function contours given in figure 5 shows that for a conventional electromagnetic flow meter the effect of the flow velocity is strong near the electrodes and decreases with increasing distance away from the electrodes.

Velocity Reconstruction:

Using the relationship $[V_i] = [W_i] [A]$, the mean flow velocity in each of the seven pixels was calculated. (NB: where V is the velocity matrix (see figure 10), W is the weight function matrix, A is the pixel area matrix and U is the potential difference matrix (see figure 9)).