Thermal Analysis of a Piezo-Disk Utrasound Probe

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Abstract

Ultrasound imaging probes are widely used for several types of diagnosis applications. Since in most cases the duration of clinical examination can be quite long, the surface temperature of the probe head, in contact with human body, must be kept under control. International Safety Standard IEC 60601-2-37 sets an upper limit for the surface temperature in still air of 50 °C (43 °C if measured when coupled thermically and acoustically with a test object having thermal and acoustical properties mimicking those of an appropriate tissue). The temperature rise is caused mainly by joule heating effect inside the active piezo-transducer and could be very important under some operating conditions (i.e. CW, Continuous Wave doppler; PW Pulsed Wave doppler; CFM, Colour Flow Mapping). In the present work we focus our attention on a disk-type probe, which is widely used in CW and PW operating conditions. In particular we present a 2D-axial symmetry FEM for the probe, capable to predict both the operative temperature values at different driving signal frequencies, both the heating dynamics. Moreover, the FEM is validated through comparison with specialized thermocouple surface temperature measurements. Finally a correlation between electric power and surface temperature is evaluated.