Purpose: To assess the temperature sensitivity and spatial resolution of an ultrasonic imaging array to be used for radiation dosimetry.

Methods: A circular array of ultrasonic transducers is used to image radiation heating of water in a phantom. The array is constructed of 128 PVDF sensors arranged in a circle of 177.8 mm radius that are multiplexed to analog input and output digitizers that are synchronized via high-precision timing and triggering circuits used for measuring time-of-flight of ultrasonic tonebursts with central frequency of 1 MHz. The time-of-flight data are inverted to obtain average water temperature along the flight path between each transmitter/receiver pair, and the ensemble of such data is passed to a filtered backprojection algorithm for tomographic reconstruction of 2D temperature profiles at a refresh rate of about 10 s per scan. The expected linear spatial resolution of the array is ~ 5mm, and the system is designed to resolve temperature changes below 1 mK. Initial testing of the system has been done with thermal stimuli provided by an incandescent spotlight which is focused in the imaging plane.

Results: With the ~7 mm spotlight filament dissipating ~60W focused in the imaging plane of the array, thermal disturbances of 2-cm fwhm in size are recorded, measuring ~10 mK near the peak and temperature resolution approaching sub-mK levels. A crude validation of the temperature sensitivity has been done by incorporating a calibrated thermistor probe near the beam hot-spot for comparison with the image data.

Conclusions: Initial testing of an imaging system based on ultrasonic thermometry indicates that the instrument may be suitable for testing in ionizing radiation beams, where it would be used for imaging 2D dose distributions in real time.