Apparatus for Real-Time Acoustic Imaging of Rayleigh-Bénard Convection\textsuperscript{1} KERRY KUEHN, JONATHAN POLFER, JOANNA FURNO, Wisconsin Lutheran College — Shadowgraph visualization of the Rayleigh-Bénard instability in optically transparent fluids has enabled comparison between theoretical and experimental work on a well defined nonlinear system. Rayleigh-Bénard convection in liquid metals, however, remains largely unexplored owing primarily to the difficulty of imaging flow patterns in opaque fluids. We have designed and built an apparatus for high-resolution real-time imaging of convective flow patterns in optically opaque fluids which takes advantage of recent advances in two-dimensional ultrasound transducer array technology. The experimental apparatus employs a modified version of a commercially available two-dimensional ultrasound camera, similar to those now employed in non-destructive testing of solids. Images of convection patterns are generated by observing the lateral variation of the temperature dependent speed of sound \textit{via} refraction of acoustic plane waves passing vertically through the fluid layer. The apparatus has been utilized to observe straight rolls in transparent 5 cSt. silicone oil. Thus far, we have not observed stable convection rolls in liquid mercury.

\textsuperscript{1}Supported by NSF grant DMR-0416787 and DOE grant DE-FG02-04ER46166

Kerry Kuehn
Wisconsin Lutheran College

Date submitted: 20 Nov 2006

Electronic form version 1.4