**15. Conversion of ultrasonic transducers from narrow axial beam to wide radial radiation with low aperture** **DRAFT 1.2**

UFO Doctor, Dec 27th, 2011

## 1. Introduction

Many years ago the ultrasonic transducer UST 40 has been applied for distance measurements using the reflection method.
This transducer, based probably on a Murata concept, operates at 40 kHz. Available are the transmitter module (UST 40T) and the receiver module (UST40R).
These modules show the dimension D16x12, Kobitone (available at mouser.com) offers smaller transducers D10x7.2mm.

All these transducers are designed for axial beam applications, but for our Duck project we need transducers with radial omnidirectional and low aperture characteristics.
(In easy words: the Mama Duck and the Baby Duck are on a flat lake, but Mama and Baby do not look always face to face!)

The conversion from axial to radial radiation is done here by a solid aluminum cone of 90 degrees, placed in front of the transducers.

## 2. Axial Transducers modified for radial radiation

Fig.1. Modified Tranducers

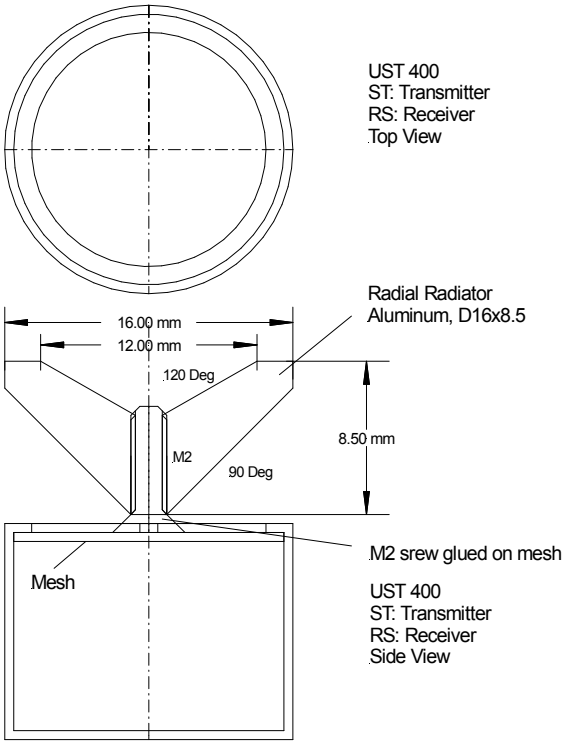



Fig. 2. Sketch of the Radial Radiator

## 3. Preliminary Experiments

Test Setup:
Acoustic Protection: Blanket against reflections
Input Voltage at transmitter transducer: 10Vpp
Measuring distance: 0.5 m

Fig. 3. Standard , transmitter and receiver axial face to face :
Received: 125mVpp

Fig. 4. Transmitter upwards with Radial Radiator, receiver standard axial:
Received: 35mVpp

Fig. 5. Transmitter and Receiver upwards with Radial Radiators:
Received: 4mVpp

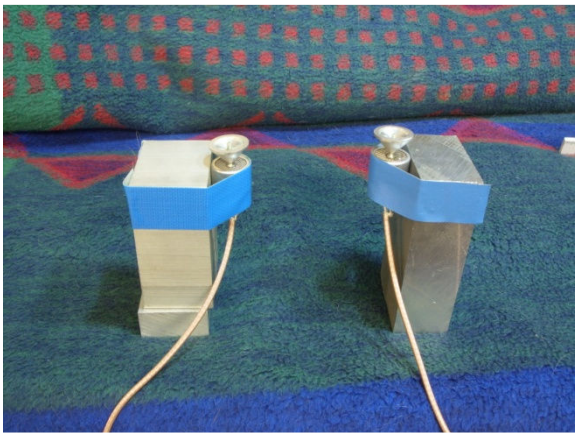


Fig. 6. Detail Transducers:
Transmitter and Receiver upwards with mounted Radial Radiators

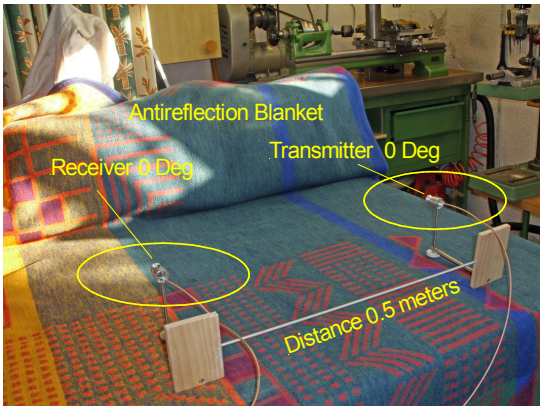
## 4. Preliminary Conclusions

The radial omnidirectional radiation at low aperture characteristics is possible.

The additional transmission losses amount here to about a factor of 32, (about 26dB) but is acceptable for our application.

## 5. Precise experiments with better antireflection blankets

T= transmitter module UST 40T, R = Receiver module UST 40R
Signal source 40 kHz, 10Vpp (permissible 20Vrms, see datasheet)




Test Setup for Test 3 and 4 for transducers with radial radiators
Fig. 7. Test Setup for Test 3,4
(Test 1,2: standard transducers without radial radiators: 0 deg = face to face)

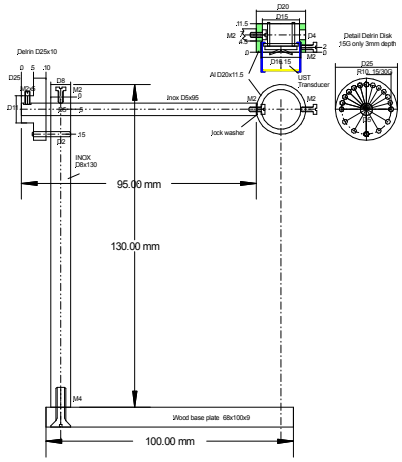



Fig. 8. Transducer manipulator for angle steps of 30° (15° available, too)

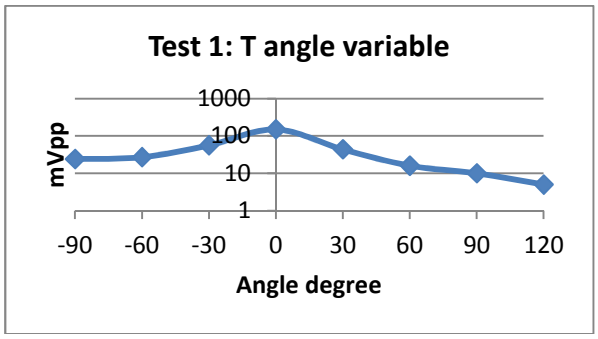



Fig. 9a. Standard transducer without modification, T rotated, R fix

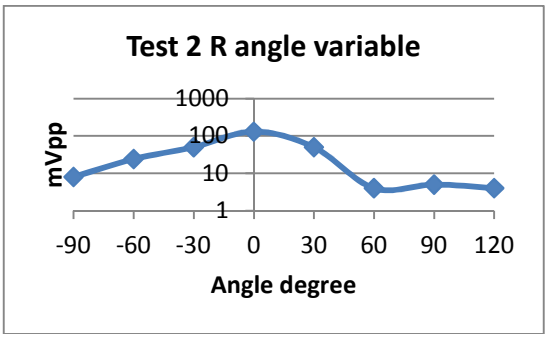



Fig. 9b. Standard transducer without modification, R rotated, T fix

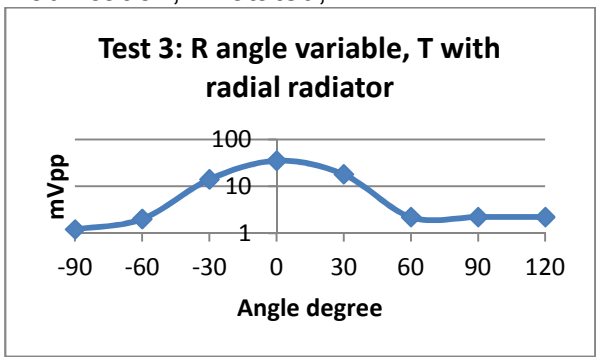



Fig. 9c. R=rotated standard transducer
T= transmitter with radial radiator

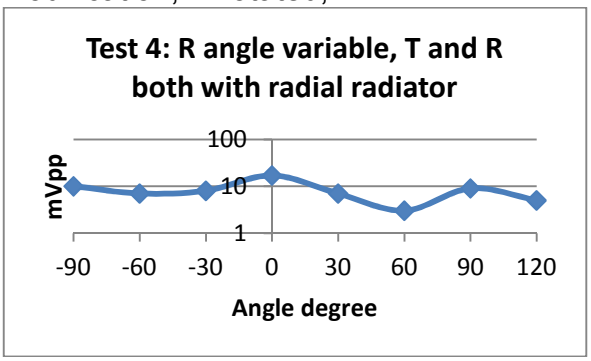



Fig. 9d. R=rotated transducer
T= transmitter, both with radial radiator

## 6. Conclusions:

Fig. 9a and Fig. 9b look similar; this means that the antireflection test setup is ok.
BUT: Switching the R module to transmission and the T module to reception means an additional transmission loss of 6dB! Module R and T are different!
The additional transmission of about 19dB with radial radiators is quite good since we distribute sound energy omnidirectional in the horizontal plane!