Cost-effective Radiation Force Balance for Calibration of Therapeutic Ultrasound Devices

Faezeh Razjouyan, Vesna Zderic, PhD

The George Washington University
School of Engineering and Applied Sciences
Department of Electrical and Computer engineering
Program in Biomedical Engineering

Objective

- The objective was to create an inexpensive, portable, and accurate Absorptive Radiation Force Balance (ARFB) to measure acoustic powers of up to 100 Watts generated by the High Intensity Focused Ultrasound (HIFU) transducer at frequency range of 1-4 MHz.
- This was done by designing a system which consisted of a precision balance, a cylindrical absorbing target, water tank, and a custom-sized gantry.

Product Specs.

Parameters	Value	Unit
Absorber diameter	2-4	inches
Absorber height (thickness)	1-4	inches
Outside dimensions of the gantry	8 x 4 x 10	inches
Inside dimensions of the gantry	5 x 4 x 4.5	inches
Water tank dimensions	8.7 x 6 x 6.7	inches
Water tank capacity	>350	Cubic inches
Operating Temperature	20-30	Celsius
Operating Frequency range	1-4	MHz
Operating Temperature	20-30	Celsius
Operating Power range	0-100	watts
Accuracy	± 20%	
Resolution	±150 (± 0.01g)	mW
Input electric power	0-100	Watts

Table 1: Product specification table

Absorbing Target

- The heart of the Absorptive Radiation Force Balance is the absorbing target.
- The difficulty lies in the fact that there is not a good recipe published for making the absorbing target. Most published literatures include no information about the procedures or the components required for making the absorber.
- The work done was based on an old recipe. However, it was obsolete since the ingredients were out of market.
- For this research, making an effective absorbing target with commercially available ingredients has been studied.
- Four different absorbing targets consisting of nickel powder, silicone elastomer, and microballoons were prepared and tested.