

# NRI: FND: OPTOACOUSTIC MATERIAL AND STRUCTURE PRETOUCH SENSING AT ROBOT FINGERTIP

NRI-1925037



**PI: Dezhen Song**  
**Co-PI: Zou Jun**  
*Texas A&M University*

# SENSOR-BASED GRASPING

- **Camera or Lidar**
  - Occlusion and appearance only
- **Tactile Sensing**
  - Require physical contact
- **Proximity sensors**
  - Optical sensors: Cannot handle transparent / highly reflective targets
  - E-field sensors: Cannot materials with low dielectric contrast to air
  - Ultrasonic sensors: Limited Lateral Resolution

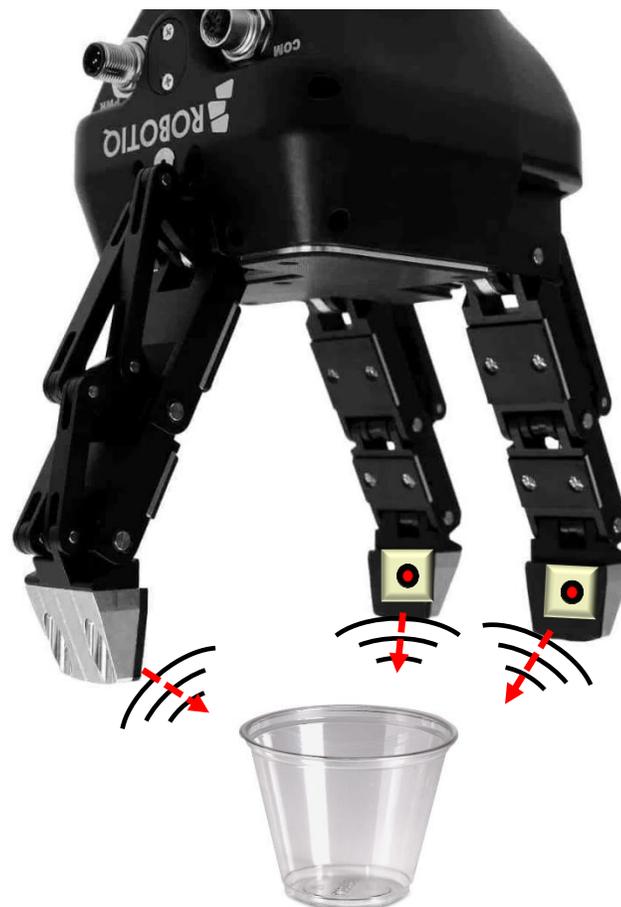


*amazonpickingchallenge.org*



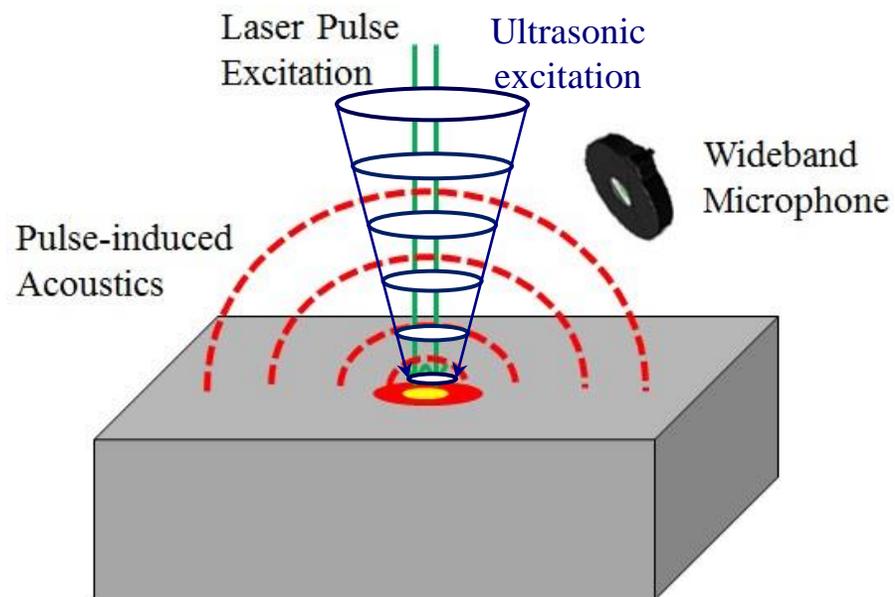
*Hsiao, Kaijen, et al. 2009.*

# NON-CONTACT MATERIAL RECOGNITION AND NEAR-DISTANCE RANGING FOR ROBOTIC GRASPING

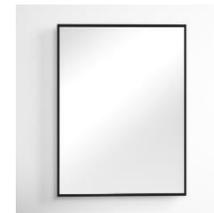


# DUAL MODALITY AND DUAL SENSING MECHANISM (DMDSM)

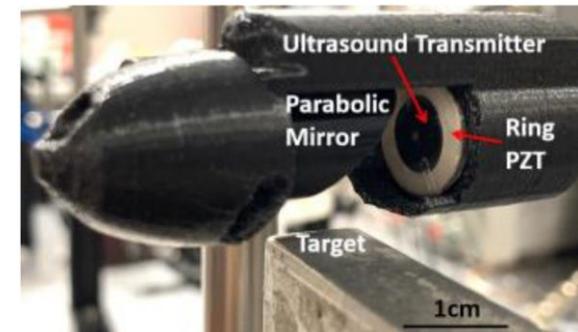
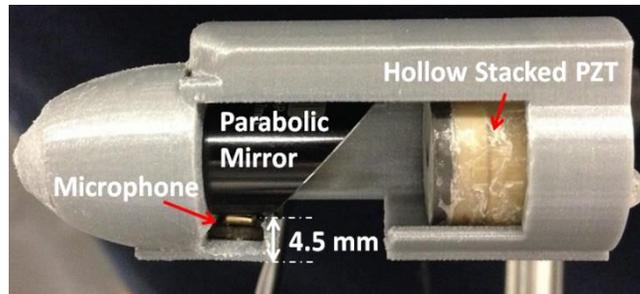
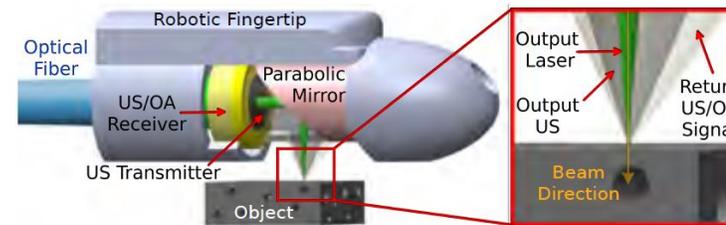
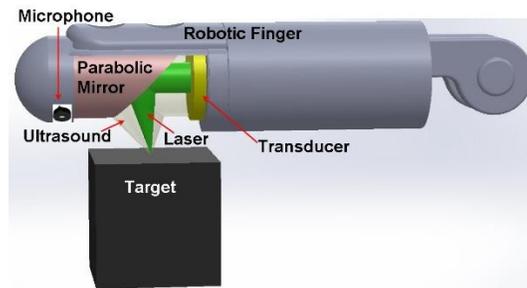
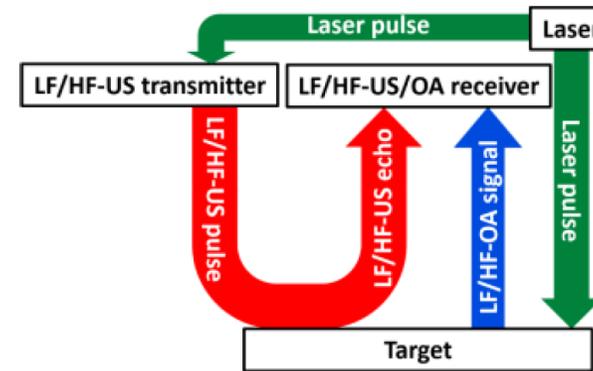
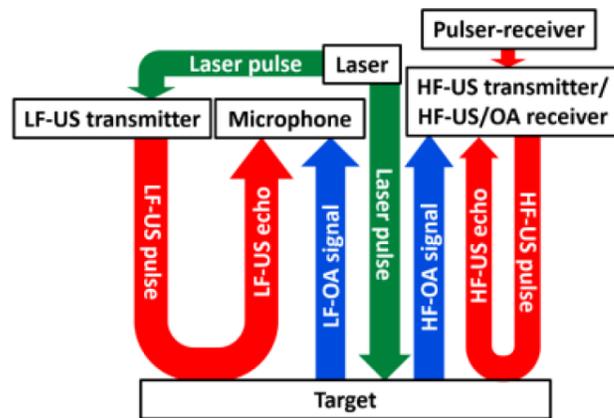
Optoacoustic Effects &  
Direct Ultrasonic Beam



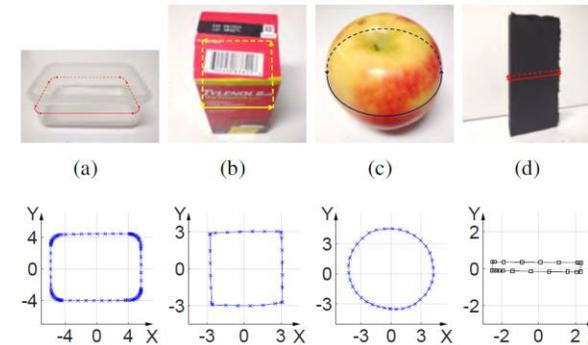
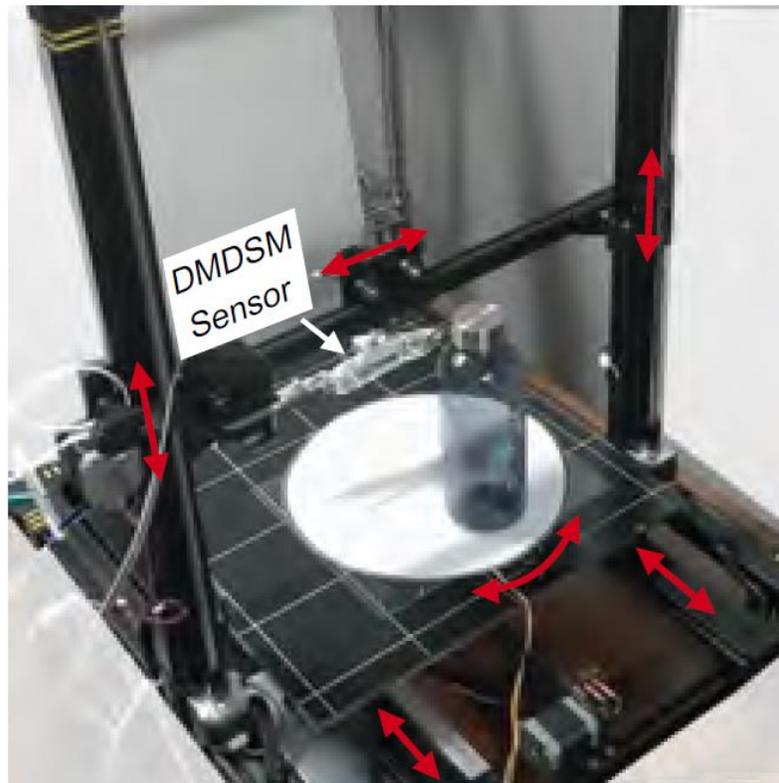
Optically and Acoustically  
Challenging Targets (OACTS)



# G1 VS G2



# OBJECT SCANNING SYSTEM – MATERIAL DATABASE



Confusion Matrix

Al	100.0	0.0	0.0	0.0	0.0	0.0	
Apple	0.0	79.0	0.0	0.0	0.0	21.0	
Foam	0.0	0.0	100.0	0.0	0.0	0.0	
Glass	0.0	0.0	0.0	100.0	0.0	0.0	
Paper	0.0	0.0	0.0	0.0	100.0	0.0	
Plastic	0.0	1.5	0.0	0.0	0.0	98.5	
Steel	0.0	0.0	0.0	0.0	0.0	100.0	
	Al	Apple	Foam	Glass	Paper	Plastic	Steel

Predicted Material

# MATERIAL DATABASE



Acrylic

Glass

Epoxy

Aluminum  
Foil

Plastic

Rubber

Sponge

Foam



Aluminum

Steel

Zinc Coated  
Iron

Copper



Bamboo

Basswood

Pine Blocks

Oak Rod

[TELEROBOT.CS.TAMU.EDU](http://TELEROBOT.CS.TAMU.EDU)