Active Microwave Thermography (AMT)

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Active Microwave Thermography

Use microwave energy as active excitation method

Two heating mechanisms, depending on material

- Dielectric heating

$$\varepsilon_r = \varepsilon_r' - j\varepsilon_r''$$

store energy

absorb energy

$$Q = \omega \varepsilon_0 \varepsilon_r'' \mid E_0 \mid^2 e^{-2\alpha z}$$

Benefits of AMT

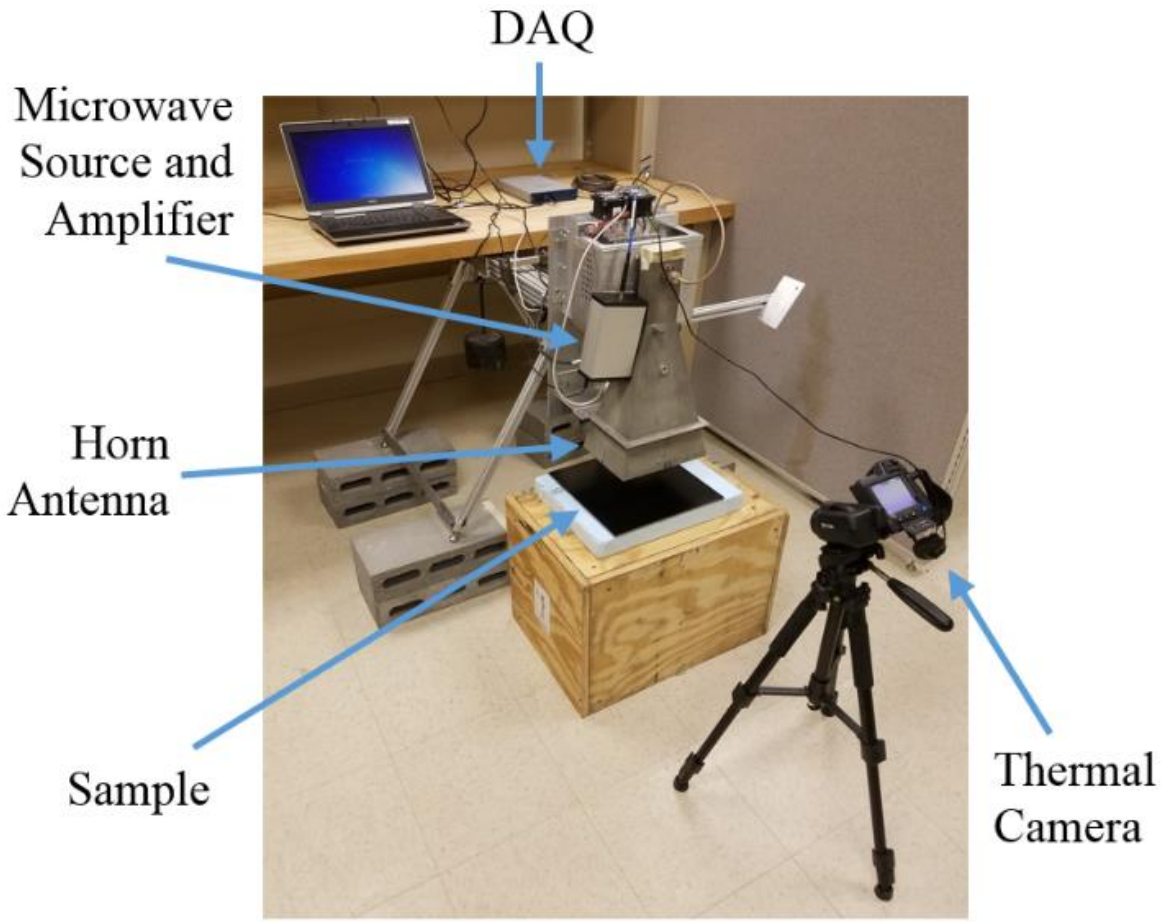
Readily deployable, fast, and non-contact

Capitalize on the legacy of thermography

Can be tailored to the inspection need

- Design the incident signal to heat specific dielectric
- Possibility of localized heating
- May reduce risk of heat damage
- Frequency and Polarization flexibility

AMT System

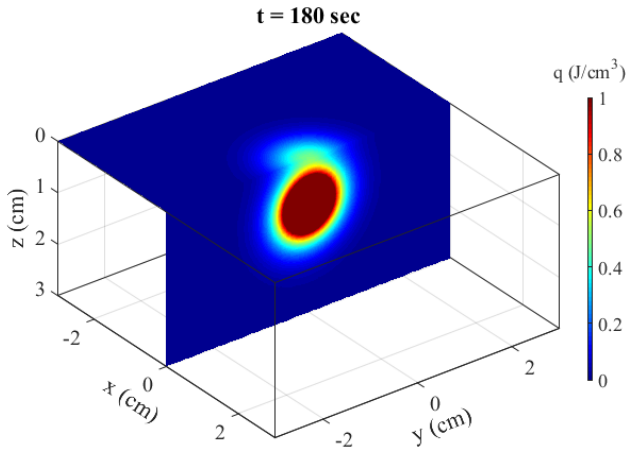

DAQ
Microwave Source and Amplifier
Horn Antenna
Sample
Thermal Camera

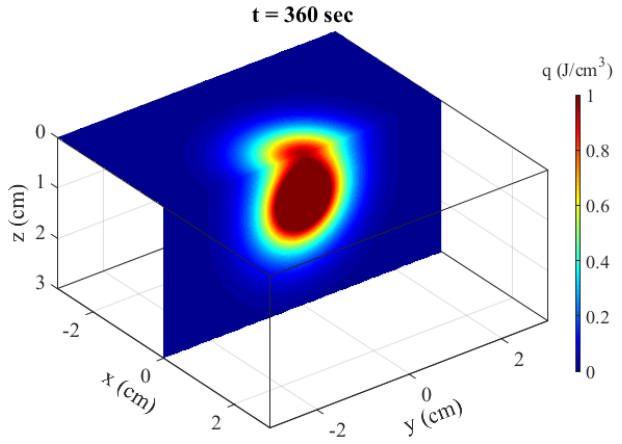
AMT Applications

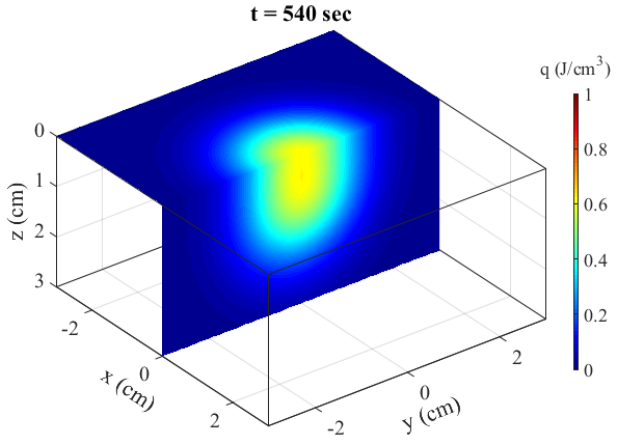
Focus so far has been infrastructure/transportation and aerospace industries

- Corrosion
- Cracks
- Moisture
- Delamination/disbond
- Subsurface defects
- Etc

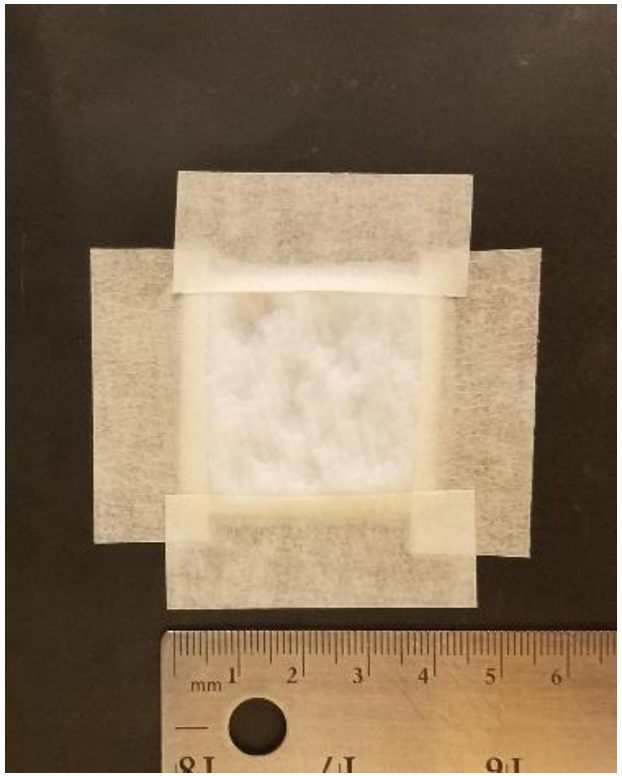
Water Ingress

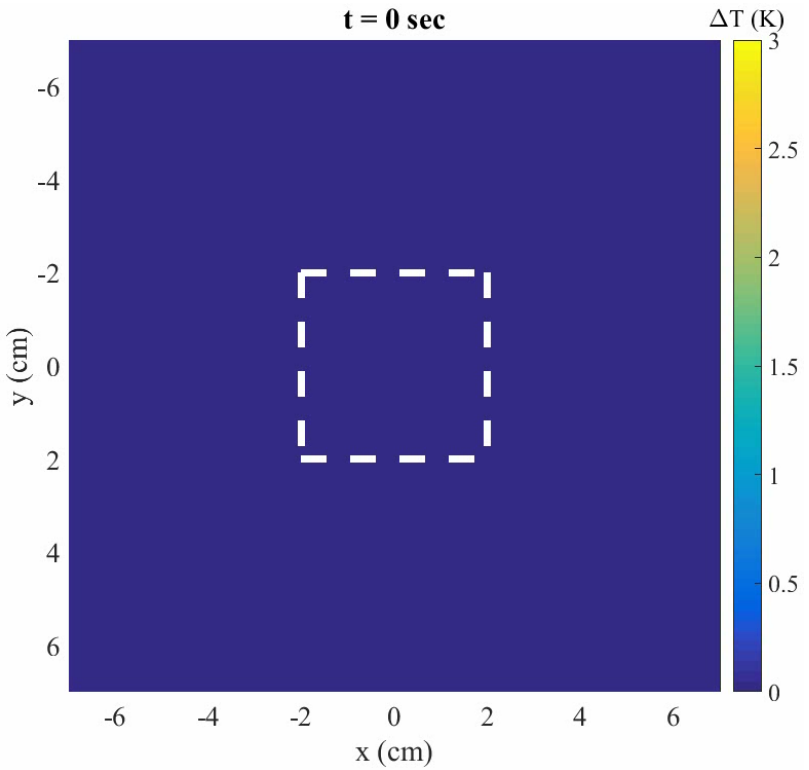






Water Ingress





Uniform Heating

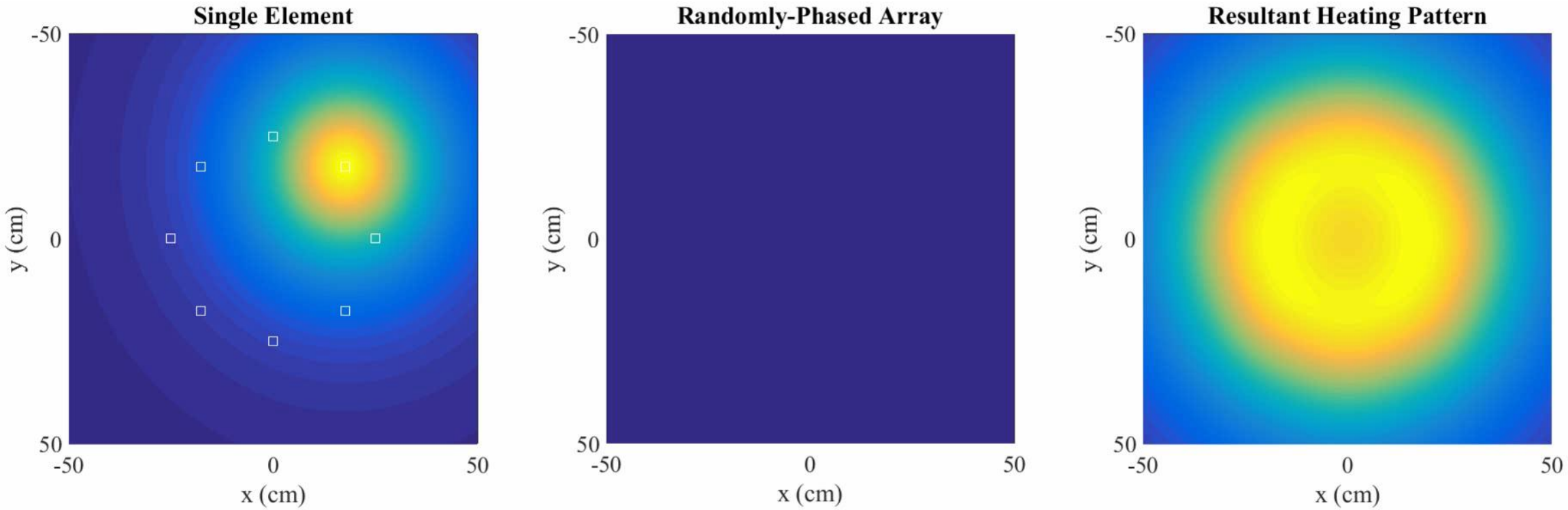
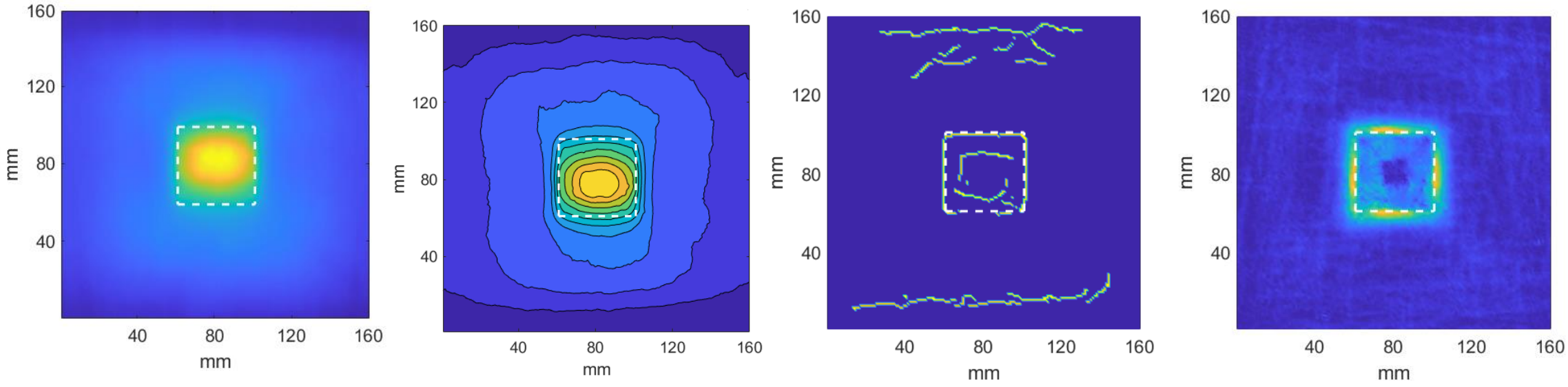


Image Post-Processing



Concluding Remarks

AMT shows strong potential in the aerospace, space, transportation, and infrastructures industries

Current works are divided into two:

- Implementation of uniform heating pattern via metamaterial lens and phased antenna array
- Implementation of image post-processing techniques from traditional thermography