# Outdoor Antenna Test Ranges

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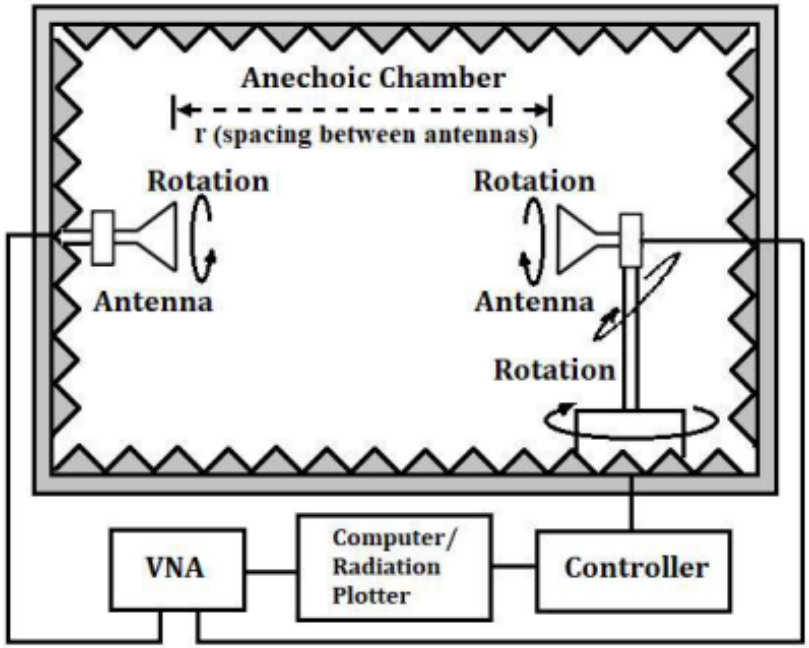
# 1. Introduction to Antenna Test Ranges

- Antenna Test Range

- Antenn test range = Antenna test space
- Outdoor range: Far-field range
- Indoor range: Far-field range, near-field range

- Instrumentation for Antenna Test Ranges [S. Suganthi]

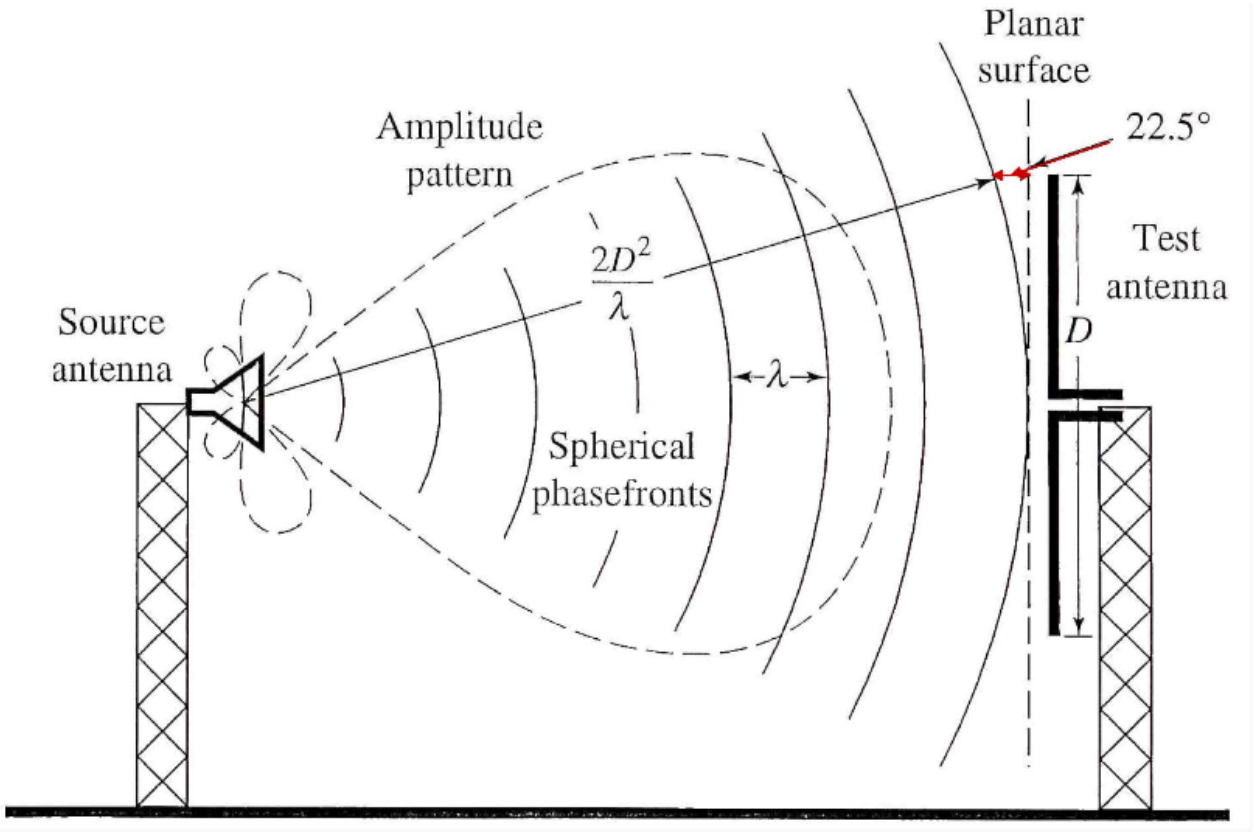
- Anechoic chamber
- Transmitting antenna with
  antenna rotator or polarization switch)
- AUT positioner: Rotation in azimuth
  and elevation
- VNA (vector network analyzer):
  Tx-Rx S21 measurement
- Computer, controller, measurement software



# 2. Far-field Antenan Test Ranges

- Far-field Condition

- Far field pattern: Use planewave to illuminate AUT (antenna under test)
- Tx-Rx separation > $D^2/\lambda$ (Fraunhofer zone), then aperture phase error < 22.5º
- Ideal condition: No reflection from ground and masts
- AUT (antenna under test): Receiving antenna to be rotated in H and V directions



# 3. Outdoor Antenan Test Ranges

- Outdoor Antenna Test Range

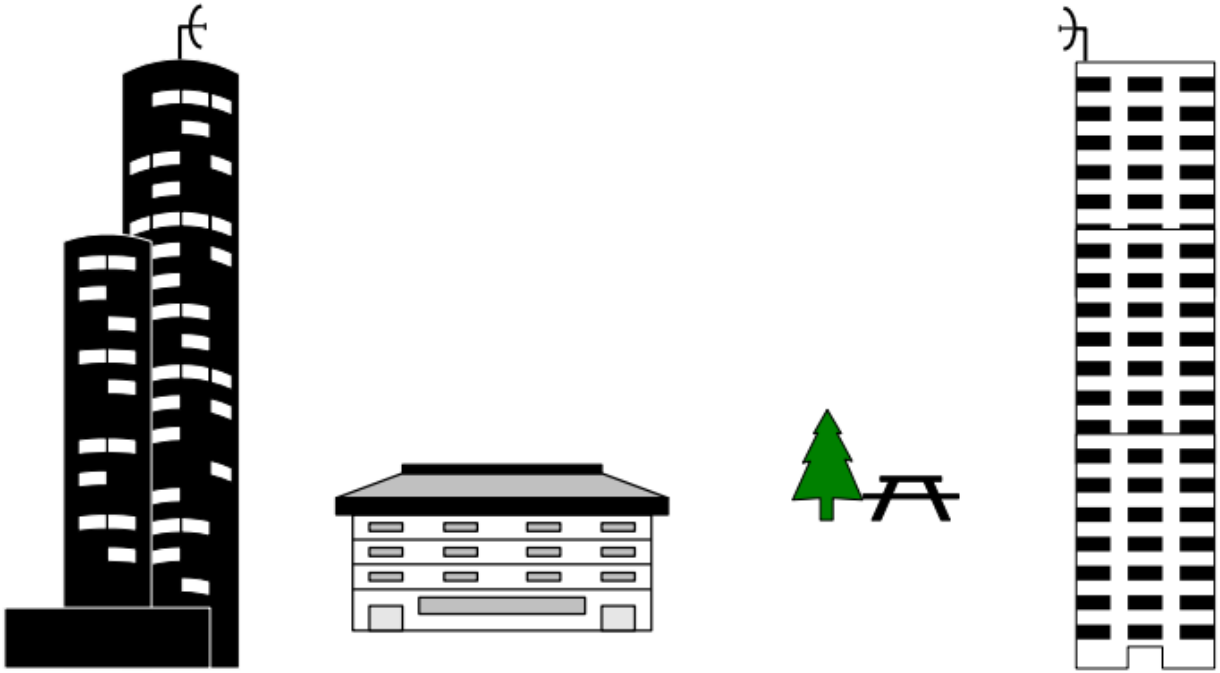
- Rooftop range range
- Arc range
- Tower range
- Slant range
- Ground reflection range
- In-situ antenna measurement

- Pros and Cons of Outdoor Antenna Test Range

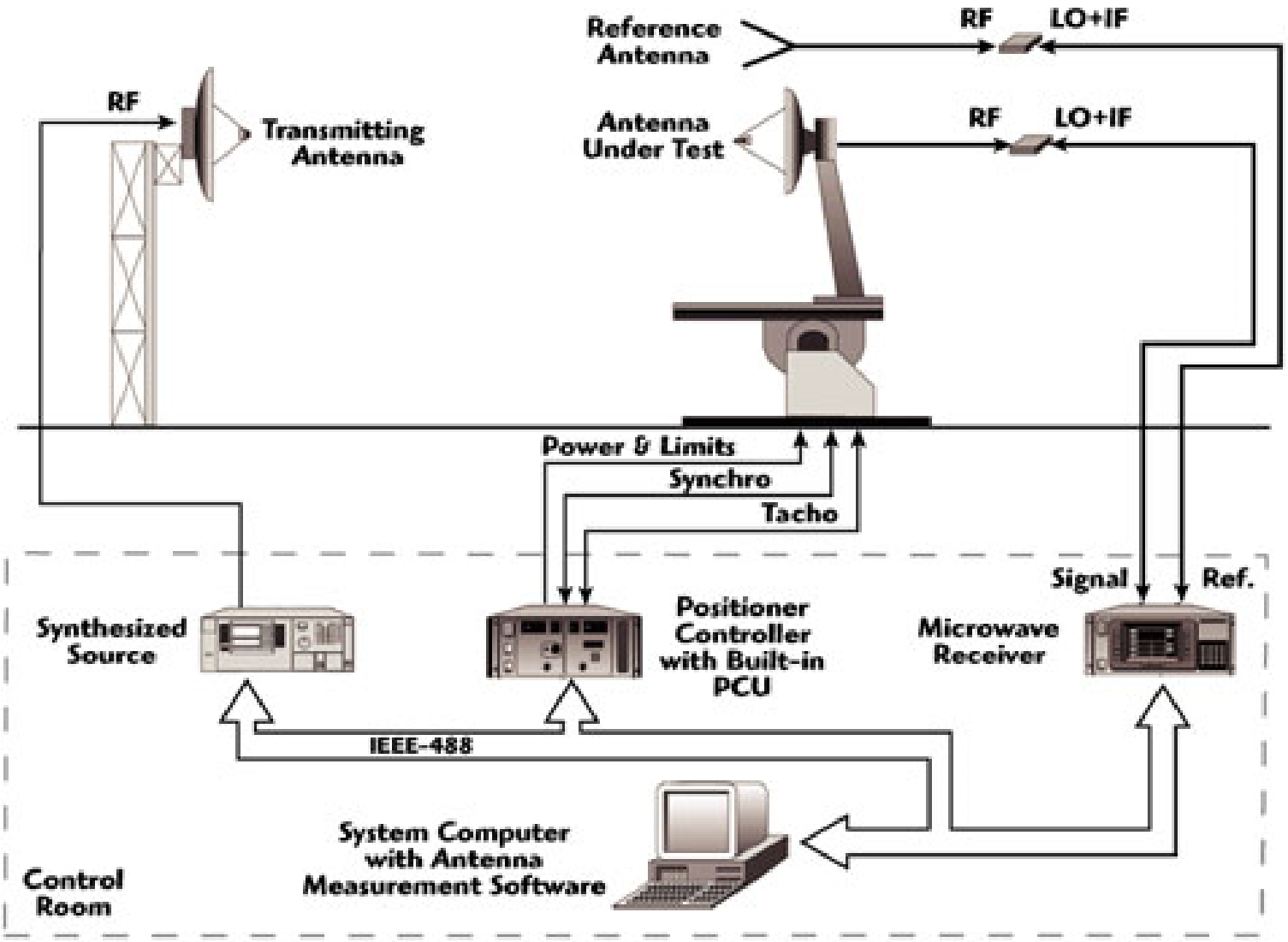
- Cost-effective
- Low-frequency tests
- Easy accommodation of large antennas
- Operation depends on weather conditions
- Susceptible to external interferences
- License required to emit radiation

# 4. Rooftop Ranges

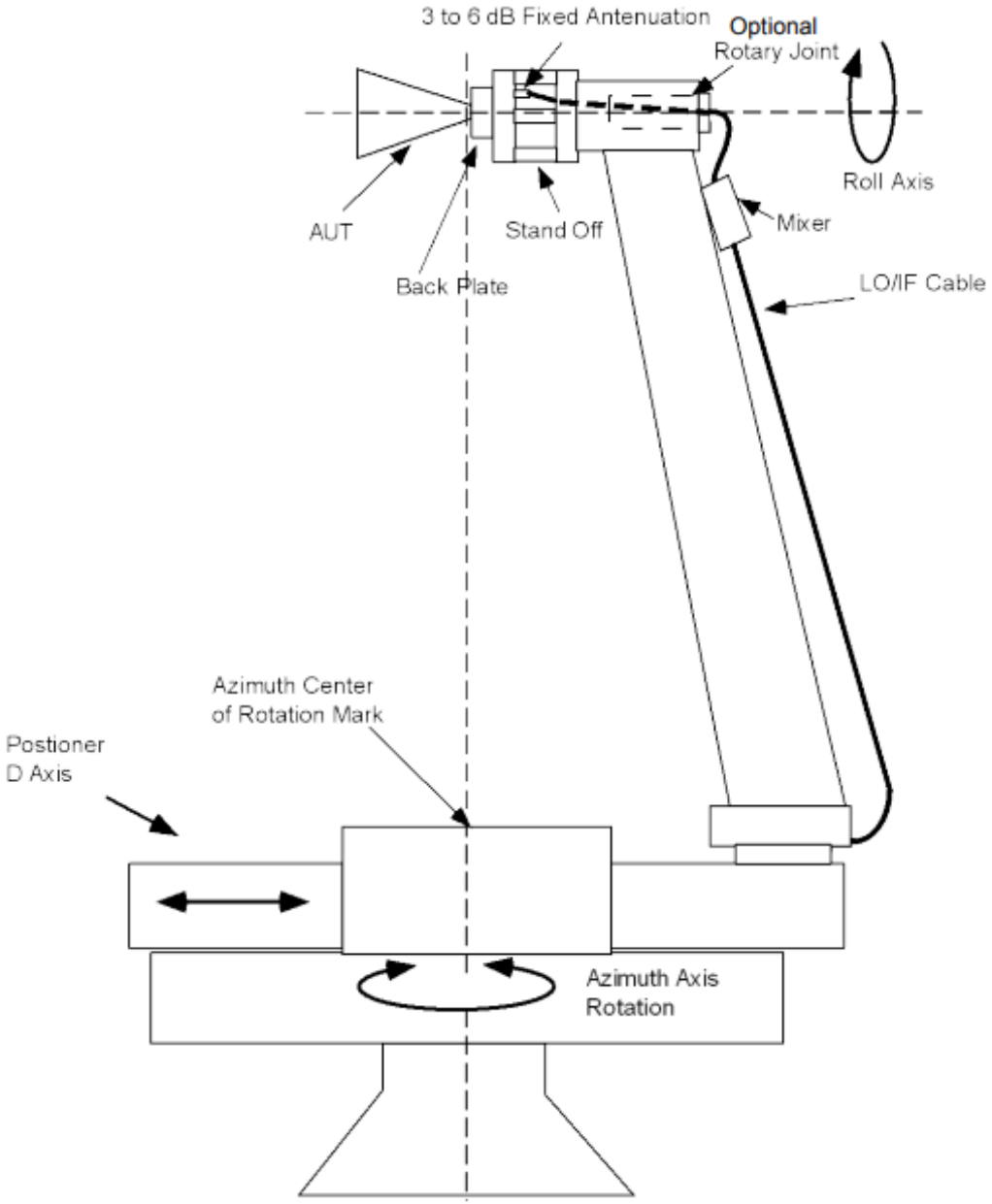
- A Rooftop-to-rooftop Range [Nikolova]



- Rooftop Range Instrumentation [J. F. Aubin]



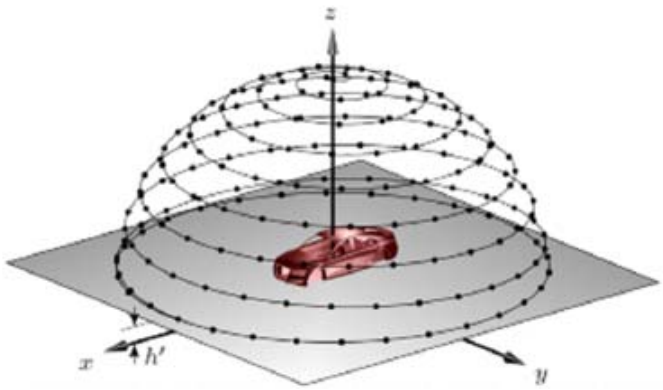
- Rooftop Range Antenna Positioner Tower [NASA]

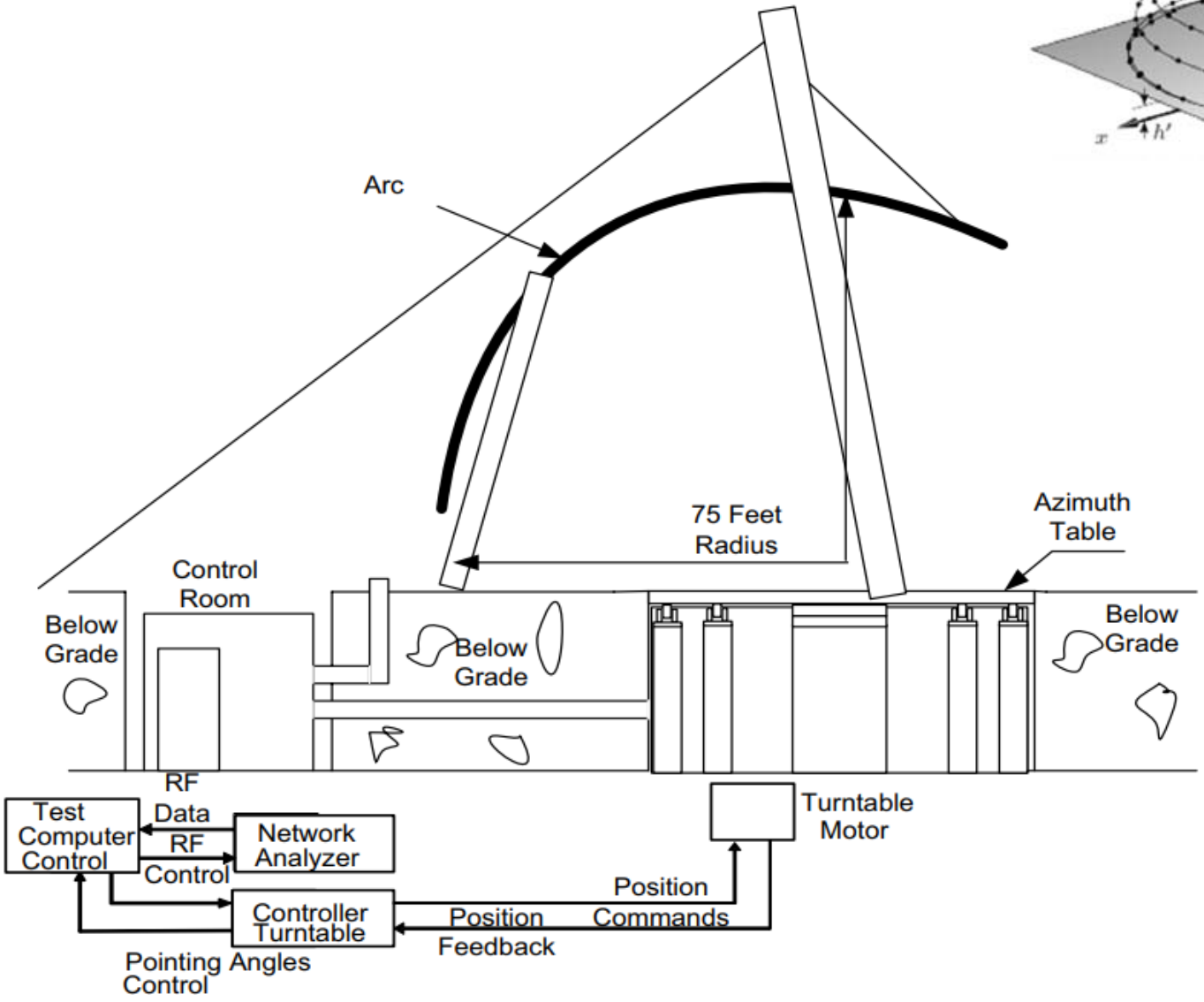


# 5. Arc Ranges

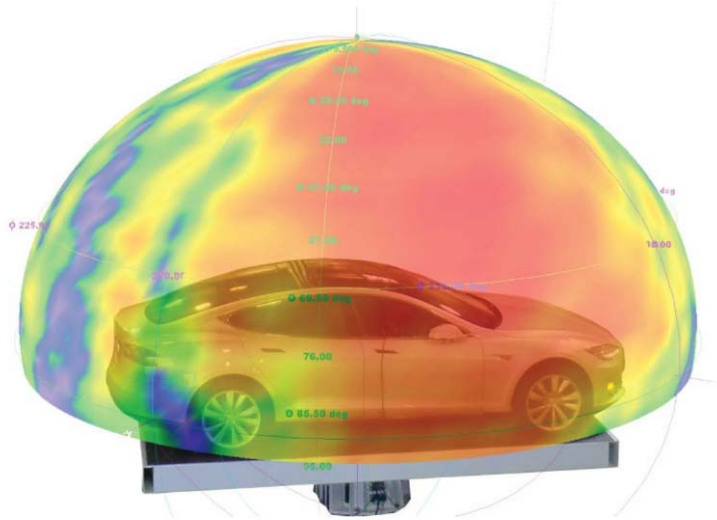
- An Arc Range [D. Kremer, J. Feng]

- Spherical far-field or near-field measurement



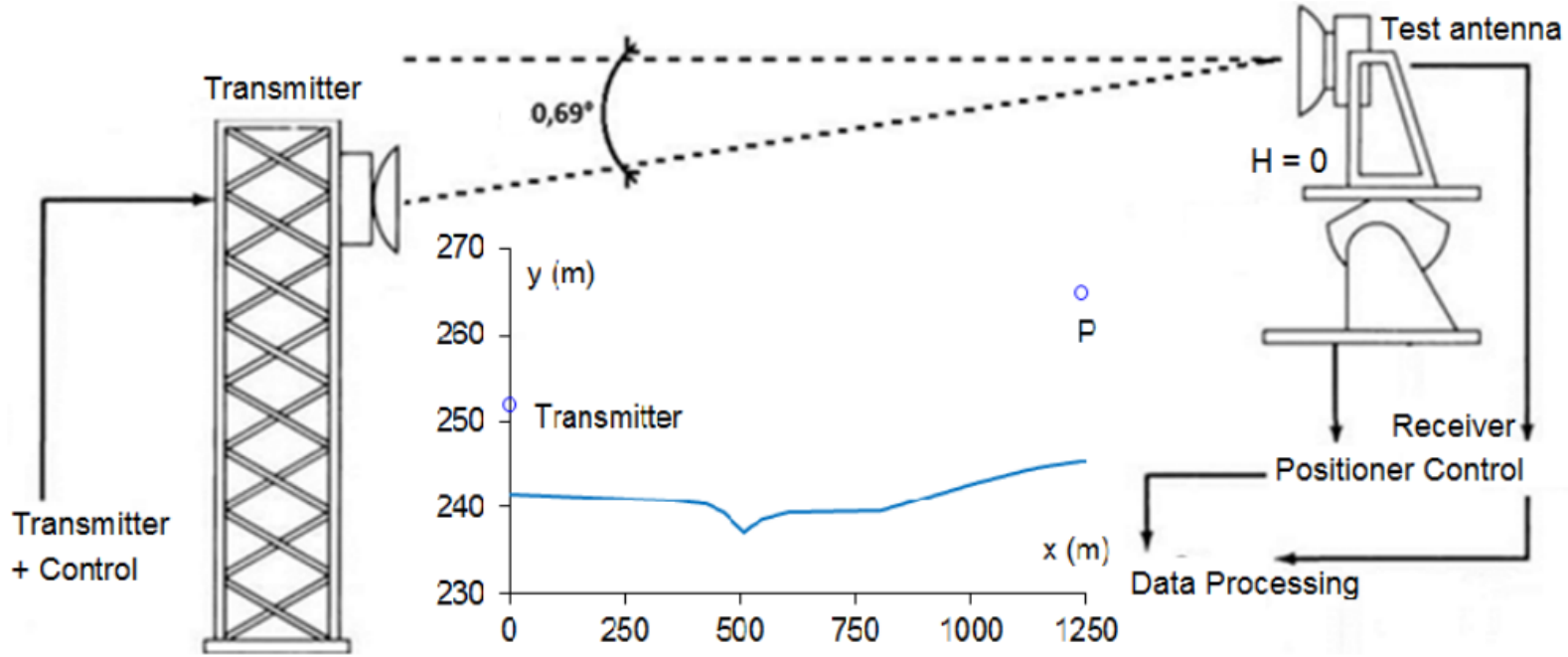


- An Arc Range for Automotive Antenna Tests [NSI-MI]

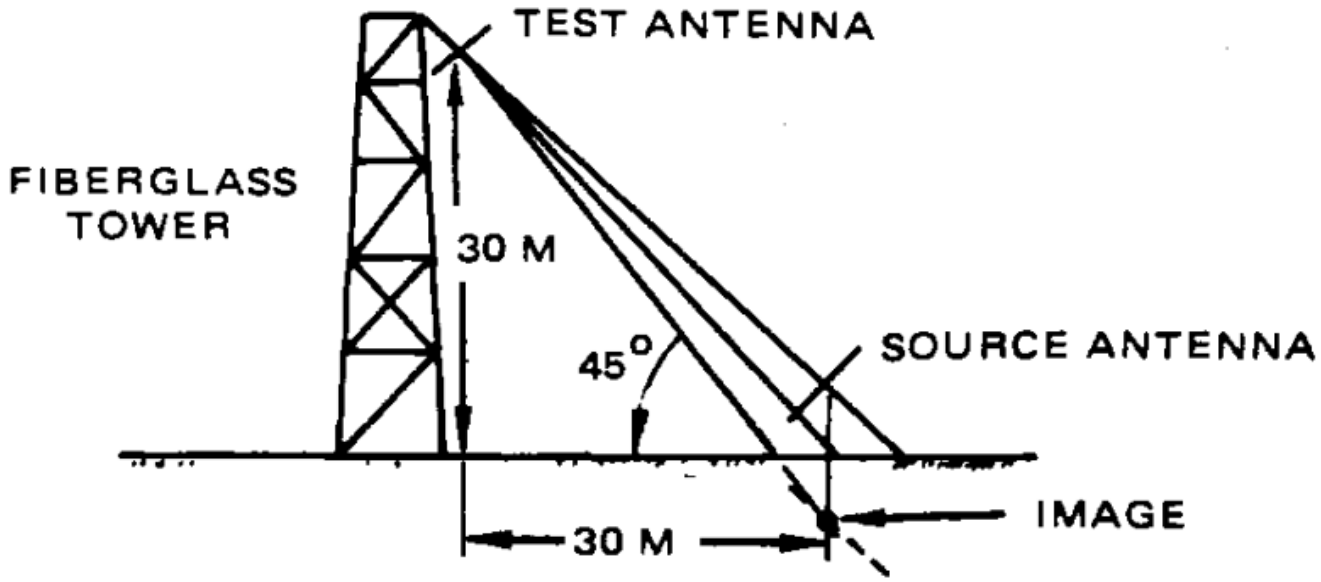
# 6. Tower Ranges

- Tower Range Configuration [Cerny]

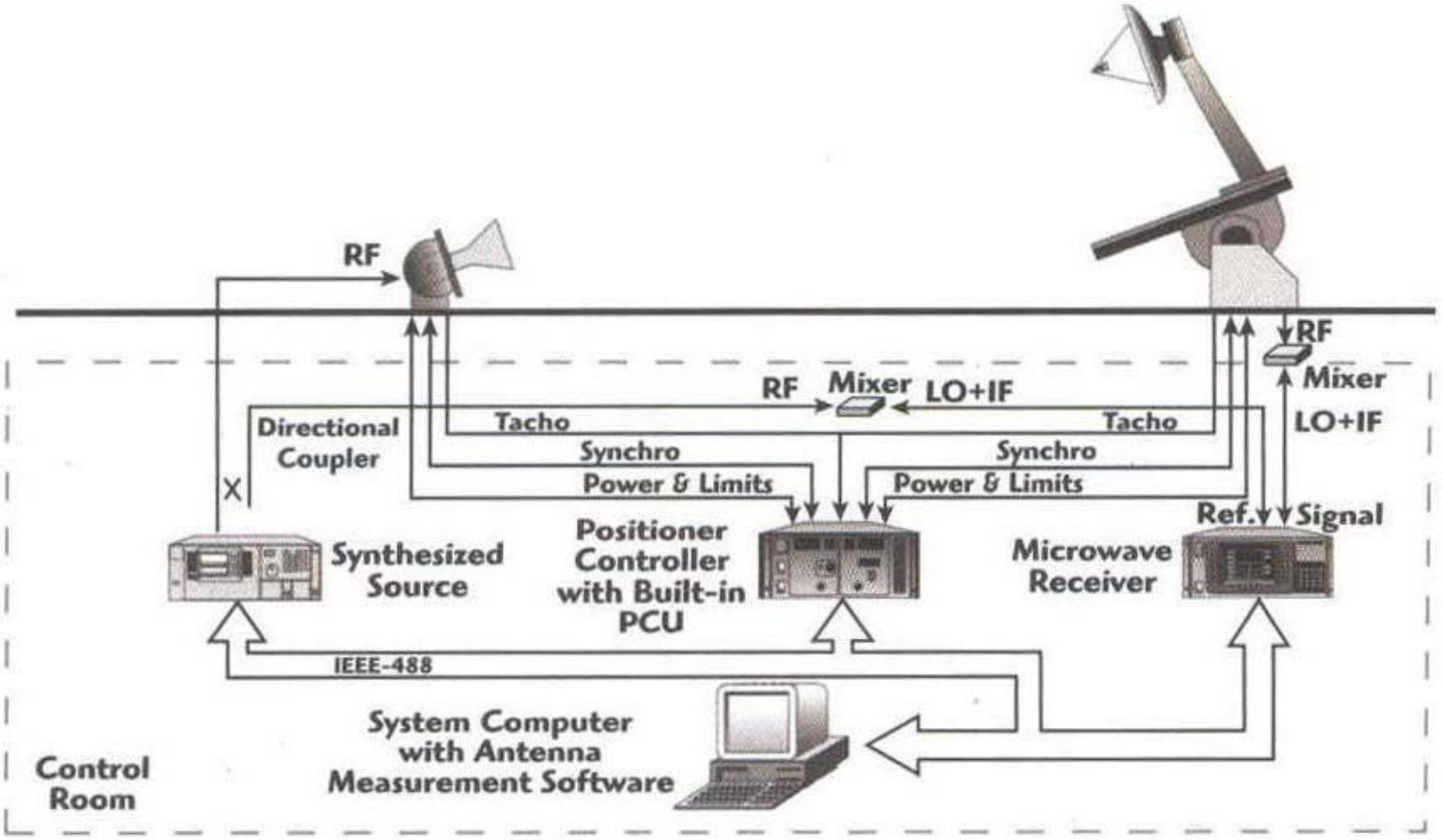



# 7. Slant Ranges

- A Slant Range [Hummer]



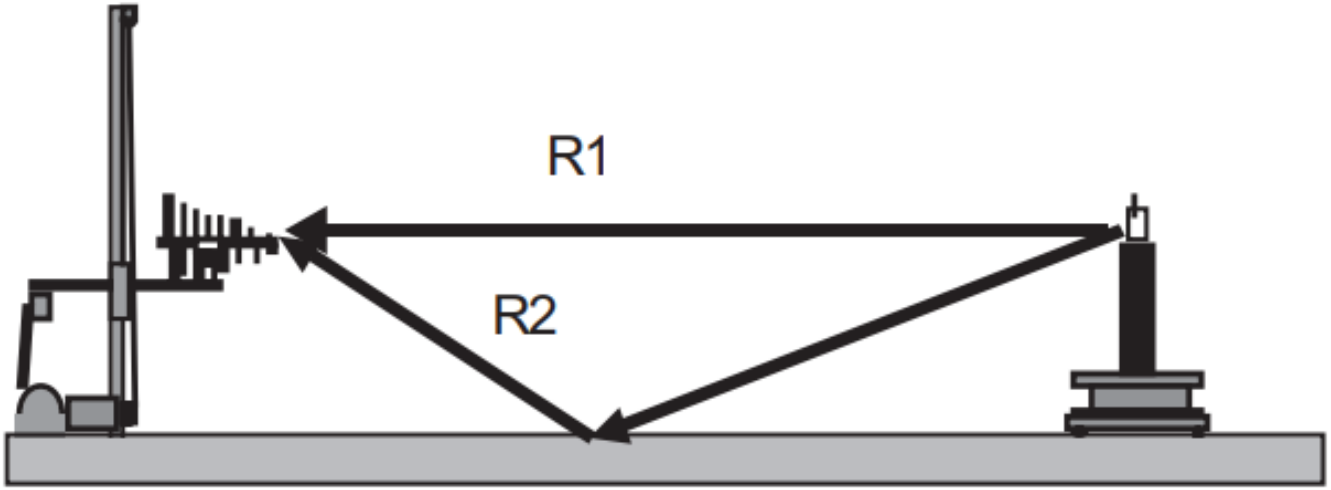
- Slant Range Instrumentaton [Orbit]

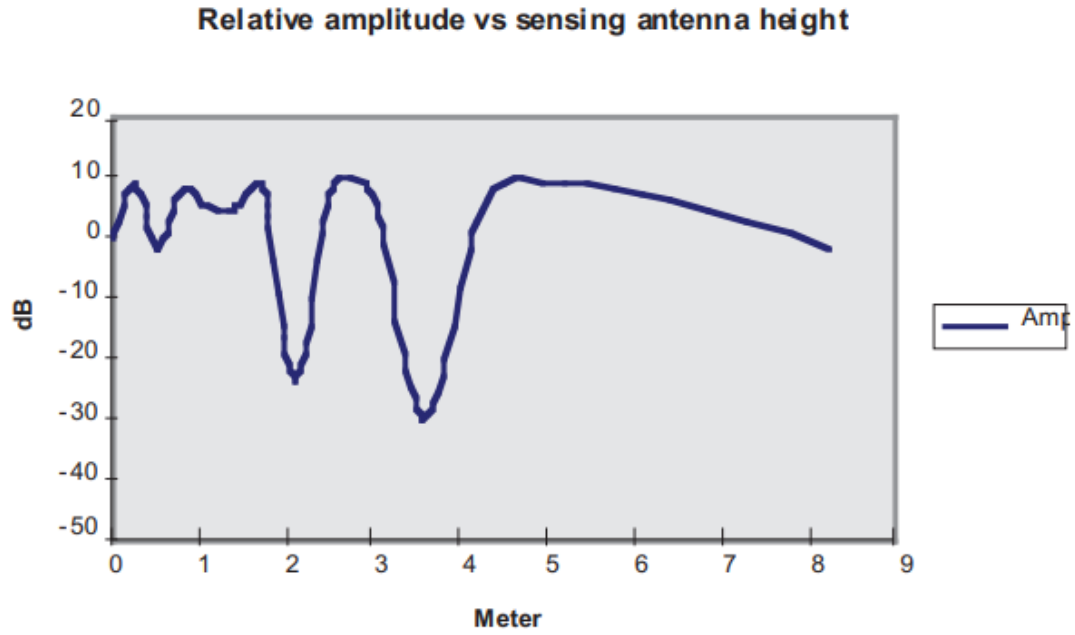


# 8. Ground Reflection Ranges

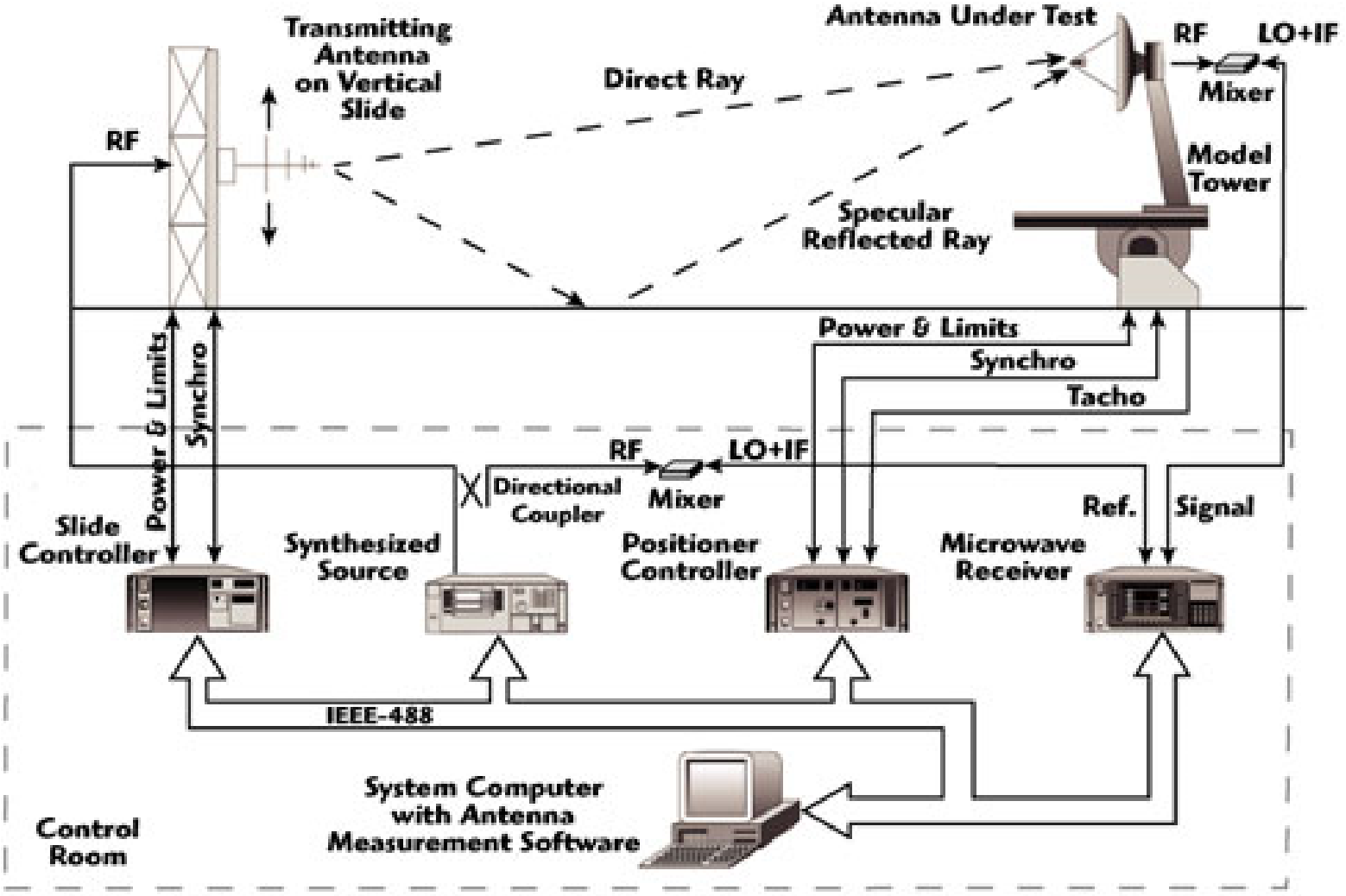
- Ground Reflection Range Configuration [S. Ooi]

- OATS (open area test site)



- Ground Reflection Range Instrumentatioin [J. F. Aubin]

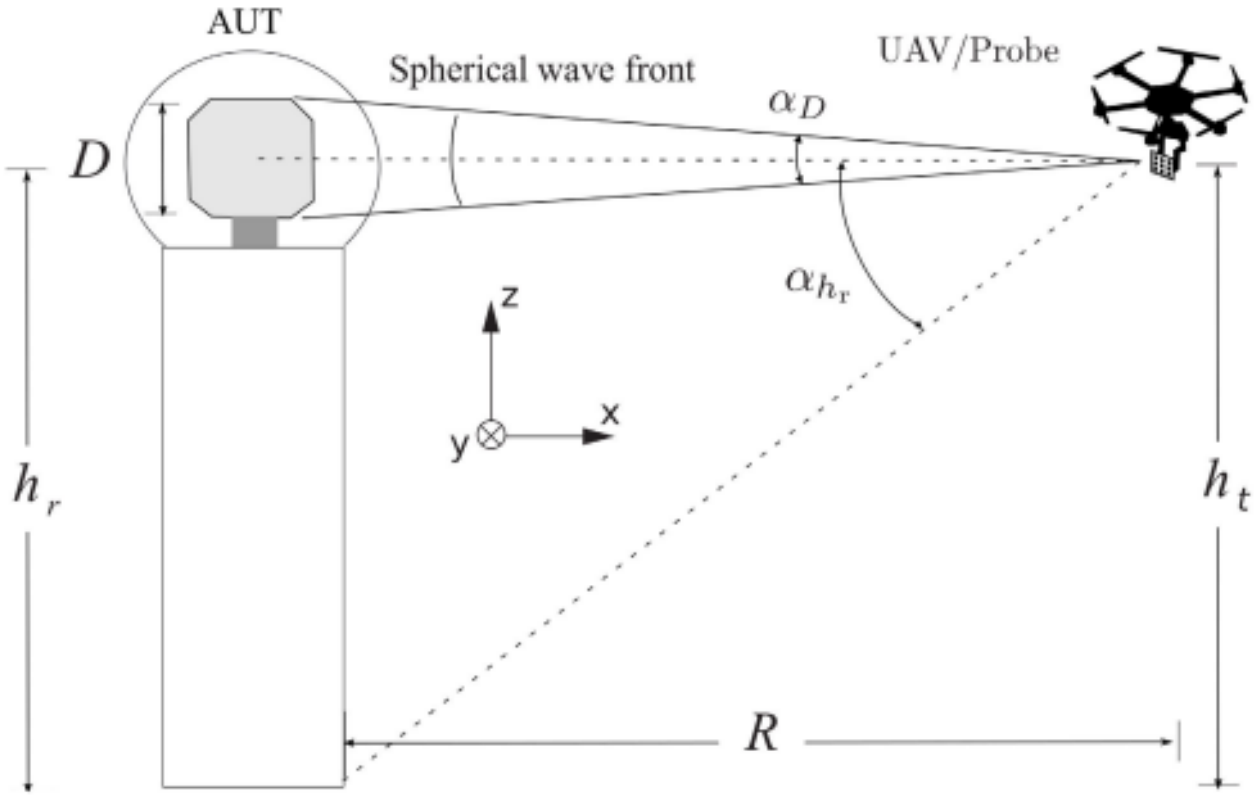


# 9. In-situ Antenna Measurements

- In-situ Antenna Measurements [Cerny]

- In-situ measurement: Measure antenna while installed

- Tx antenna: Aircrafts, small drones, satellites, celestrial bodies



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