



ECE 495 – Electromagnetic Warfare and Survivability

Block 1: Radar Fundamentals Lesson 9: Project 1 Work Day

Juan Jurado, Col, USAF, Ph.D.
Permanent Professor and Head
Electrical and Computer Engineering
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Project 1: The Ask



Your group is the survivability analysis cell supporting B-21 mission planning.

Product: the range at which each threat radar class first detects the B-21, as a function of aspect and band — with uncertainty a planner can use.

- Everything you need is in L1–L8: range equation, RCS, IADS taxonomy, $S_{\min}$
- Handout + RCS table + starter skeleton are posted
- Results presentations at L10 — 10 minutes, 5 of Q&A, everyone speaks

Detection range is not a number — it's a shape.

The Scenario: Three Radar Classes

A notional adversary IADS sector, layered as in L7:

Class	Band	f	P_t	$G_t = G_r$	$S_{\min}$
EW	UHF	0.5 GHz	2 MW	25 dBi	-158 dBW
ACQ	S	3 GHz	1 MW	30 dBi	-160 dBW
TTR	X	10 GHz	100 kW	35 dBi	-150 dBW

- Same notional parameters as the L7 companion script — your old code works here
- Free space, monostatic, detect at $S \geq S_{\min}$

B21_RCS_Table.csv: notional RCS in dBsm, 5° aspect steps, nose to tail, in all three threat bands.

- **Band matching** — own band, own column: EW $\rightarrow$ UHF, ACQ $\rightarrow$ S, TTR $\rightarrow$ X
- **Symmetric** about the nose–tail axis — the table covers the full circle
- **Uncertainty** — every value is the center of a ± 3 dB interval. How you carry it to range is your call to defend

Note where LO works hardest — and where it doesn't. The bands disagree.

1. **Detection range vs aspect** — $R_{\max}(\theta)$ per class, in band. Justify your binning
 2. **Uncertainty** — propagate ± 3 dB of RCS into km
 3. **Visualization** — one picture that tells the whole story
 4. **Ingress implications** — which class, which aspects, by how much. With numbers
 5. **Recommendation** — one slide to the mission planning cell
- **Innovation bonus** — up to +5% for going meaningfully beyond the baseline ask

The skeleton handles plumbing so you start at the physics:

- Loads `B21_RCS_Table.csv` and converts $\text{dBsm} \rightarrow \text{m}^2$
- Defines all three threat classes as a cell array
- Computes one worked $R_{\max}$ so you can verify your pipeline
- Marks where your analysis begins with TODO blocks

Example File: `L9_Project1Starter.m`

Verify the worked number first. Then build.

- **First 10 min** — groups assigned, claim a whiteboard, read the handout together
 - **Next 30 min** — divide the work: pipeline, uncertainty, visualization, story
 - **Last 10 min** — regroup: what's done, what's blocked, who owns what before L10
- I am floating between groups — pitch me your approach early.

Plan the presentation first — it tells you what to compute.

Before you leave:

- Pipeline verified against the skeleton's worked number
- Task owners assigned through L10
- Questions for me in writing tonight, not at 0700 before class

Next lesson:

- **L10: Project 1 results presentations** — slides + code due before class
- **HW1 due** at the start of L10
- **Quiz 1** (open book, 15 min) in class, tied to your project work