ENGINEERING PORTFOLIO

Ashiqul Islam (Nayeem)

Aerospace & Defense Engineering

niaain10@gmail.com — +1 (204) 887-6259 — https://www.linkedin.com/in/ashiqul-islam-nayeem-eit-157a79146/

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Technical Summary

Systems-oriented aerospace engineer experienced in modeling, analysis, and verification of complex mechanical and aerospace systems. Skilled in translating engineering theory into validated system-level results.

Core Competencies

- Systems Engineering, Requirements Analysis
- Control Systems, Dynamic Modeling
- Structural Dynamics & Vibration Analysis
- Propulsion and Thermodynamic Analysis
- Modeling & Simulation (MATLAB, Python)
- Verification & Validation (V&V)
- Training Support & Delivery
- Simulator & Scenario Support
- Technical Documentation & SOPs
- Systems Thinking & Analysis
- Customer-Facing Program Support
- Stakeholder Engagement (Gov / DND)
- Test & Evaluation Support
- Requirements Analysis
- Operational Procedure Development
- Cross-Functional Collaboration
- Data Analysis & Reporting
- Continuous Improvement Mindset

Space Telescope Shipping Container — Systems Design and Dynamic Validation-Mech 4860(Capstone with Magellan Aerospace)

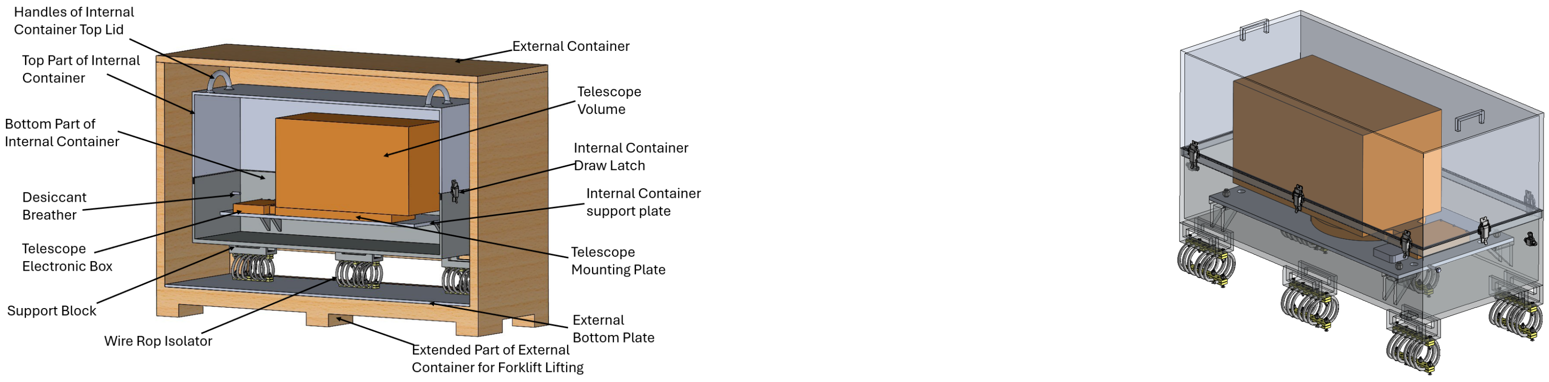


Figure 1: **Space telescope shipping container system design and dynamic performance.**

What: Designed and validated a shipping container for a high-value space telescope payload, ensuring mechanical protection and vibration isolation.

How: Applied systems engineering methodology, requirements flowdown, dynamic modeling, and frequency-domain vibration analysis.

Results: Delivered traceable system architecture meeting aerospace payload protection requirements at $10,000. Reduced vibration transmissibility and maintained stability margins.

Engineering Focus: Systems engineering, dynamic modeling, vibration isolation, verification & validation (V&V).

Aircraft Wing Design & Optimization- Mech 3520(Aerodynamics)

What: Designed and analyzed an aircraft wing for structural strength, weight optimization, and improved aerodynamic performance.

How: CAD modeling of spars, ribs, and skin; FEA for bending, torsion, shear; CFD simulations; iterative optimization for lift-to-drag ratio and weight reduction.

Results: Optimized wing improved lift-to-drag ratio, structural stresses within allowable limits, reduced weight, and enhanced flow uniformity.

Engineering Focus: Structural design, aerodynamic analysis, FEA, CFD, trade-off studies.

Aircraft Materials Selection & Manufacturing- Mech 4192(Aircraft Materials)

What: Selected optimal material and manufacturing process for a hollow circular beam under 4000 N flexural load.

How: Calculated minimum modulus and tensile strength, applied Rule of Mixtures for composites, evaluated fiber-matrix compatibility, minimized weight.

Results: Selected Carbon Fiber-Reinforced Epoxy (weight 0.122 kg), rejected aluminum, steel, and S-glass composites.

Engineering Focus: Material selection, composite mechanics, lightweight design, manufacturing process.

Turboprop Propulsion System Design & Analysis- Mech 4200(Gas Turbine & Propulsion System)

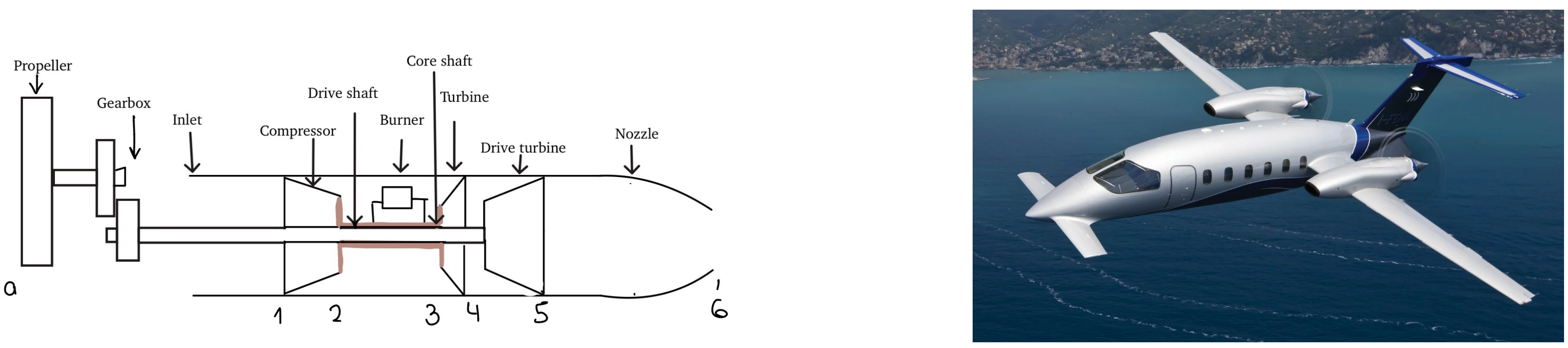


Figure 2: **Gas turbine cycle and propeller performance evaluation.**

What: Designed and analyzed a turboprop system to meet shaft power and thrust requirements efficiently.

How: Brayton-cycle modeling, propeller matching, parametric performance studies using MATLAB/Python.

Results: Achieved target shaft power, high propeller efficiency, acceptable propeller tip Mach numbers.

Engineering Focus: Gas turbine cycle analysis, turboprop sizing, propeller aerodynamics.

Table 1: Operational Turboprop Engine Comparison

Parameter	**PT6A-66**	**Garrett TPE331**	**PT6A-140**	**Project Design**
Power (HP)	850	750	900	∼828
Diameter (ft)	8.2	7.5	8.7	8.0
Blade Count	5	4	3	5
Prop RPM (max/cruise)	2000/1700	2000	2090/1900	2175/1950
Prop Eff. (%)	85–88	87	85–88	90

Miniature Turbojet Engine Performance Analysis- Mech 4200(Gas Turbine & Propulsion System)

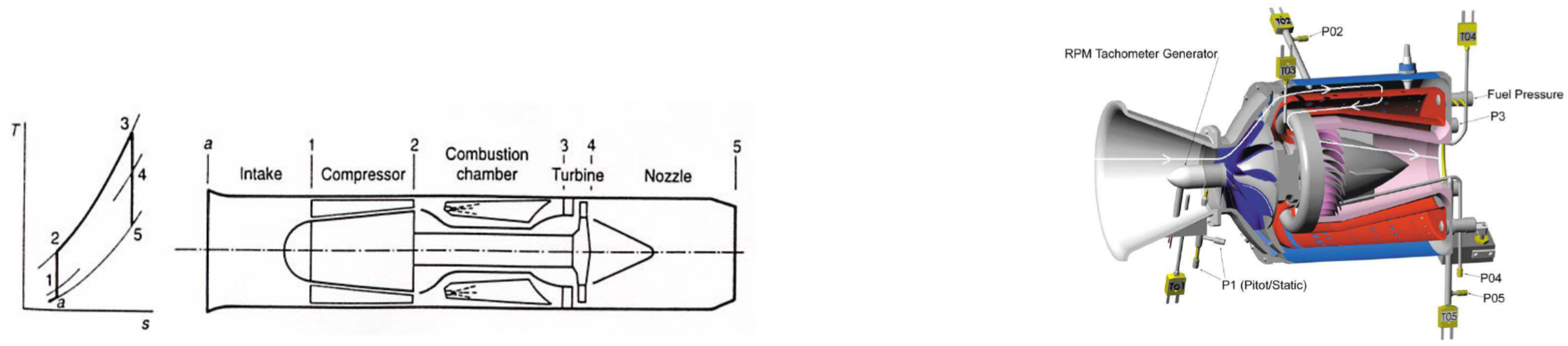


Figure 3: **Miniature turbojet engine performance evaluation.**

What: Evaluated performance of a miniature turbojet engine in laboratory conditions.

How: Measured pressures, temperatures, fuel flow, and RPM; applied thermodynamic calculations for thrust, SFC, and efficiency.

Results: Quantified deviations from ideal cycle predictions; identified component inefficiencies.

Engineering Focus: Propulsion testing, thermodynamics, data analysis.

Aircraft Landing Gear Vibration Analysis-Mech 3420(Vibrations & Acoustics)

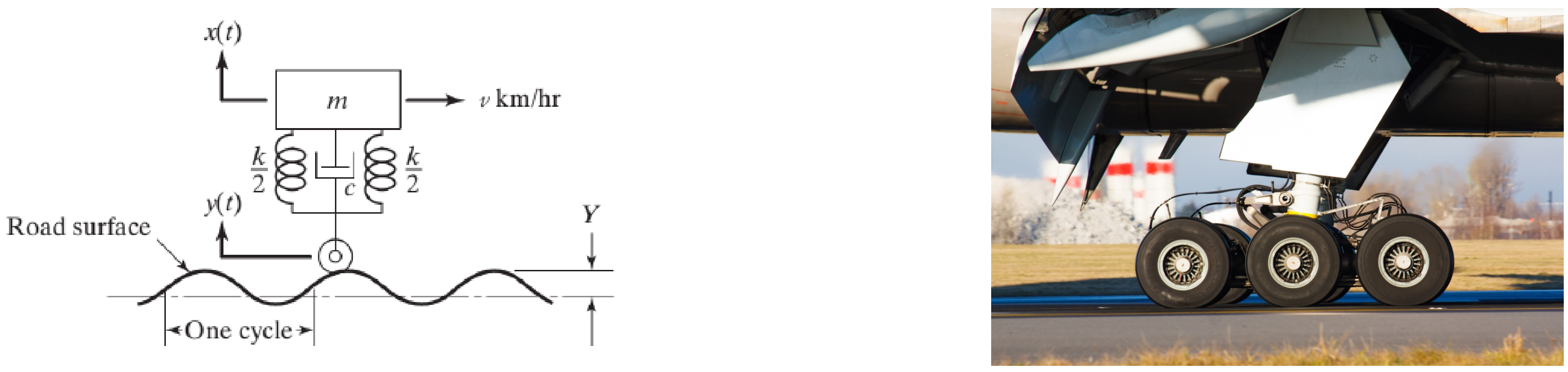


Figure 4: **Experimental vibration testing and modal analysis of landing gear system.**

What: Analyzed dynamic behavior of landing gear system to identify natural frequencies, damping ratios, and mode shapes.

How: Impact hammer testing with accelerometers; MATLAB used to compute frequency response functions and extract modal parameters.

Results: Dominant vibration modes identified; experimental modal properties validated analytical models.

Engineering Focus: Structural dynamics, experimental modal analysis, MATLAB signal processing.

Classical Control Systems Design- Mech 3430(Measurement & Control System)

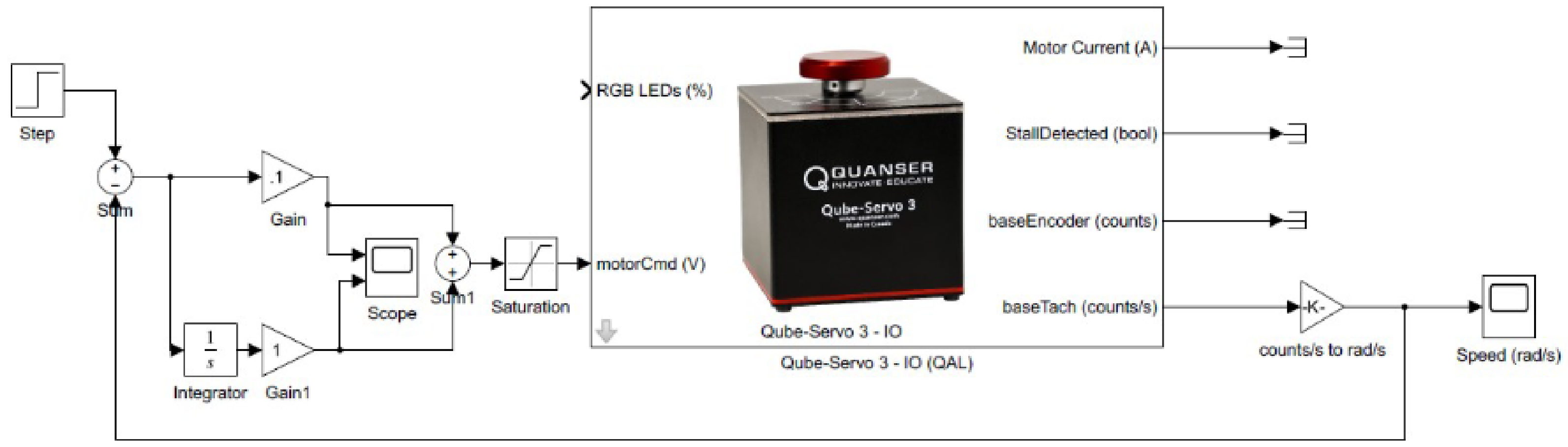


Figure 5: Control system design and frequency-domain validation

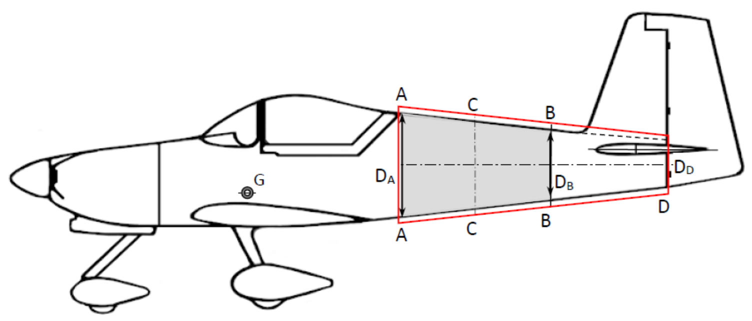
What: Designed feedback controllers to satisfy stability, transient, and steady-state requirements.

How: Developed transfer functions, designed PI,PD and PID/lead-lag controllers, evaluated frequency-domain margins.

Results: Stable closed-loop performance achieved with improved accuracy and response.

Engineering Focus: Control systems, root-locus, frequency-domain analysis.

Rear Fuselage Stringer Design — Structural Analysis- Mech 4182(Aircraft Structure)



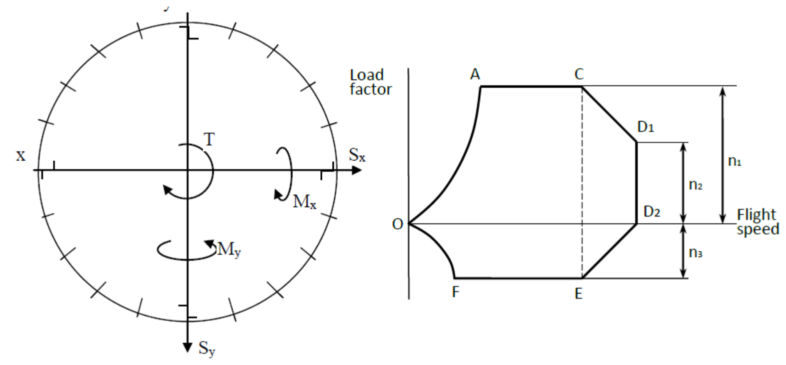


Figure 6: **Rear fuselage geometry, loading, and stringer stress distribution.**

What: Performed structural analysis and preliminary sizing of rear fuselage stringers under combined bending.

How: Modeled fuselage as thin-walled structure with booms; computed section properties and bending stresses.

Results: All stringers met allowable stress; critical section identified.

Engineering Focus: Aircraft structures, thin-walled beams.

Phase 2 Engineering Design — Requirement-Driven Refinement- Mech 3992(Thermofluid Lab)

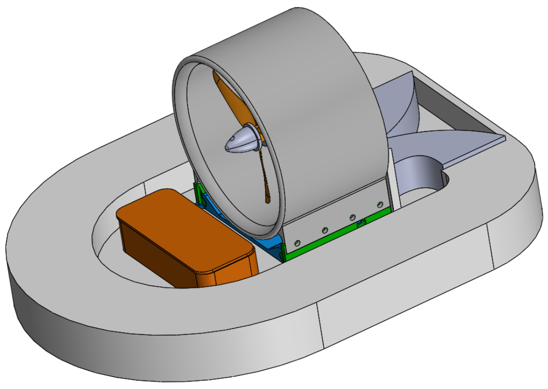
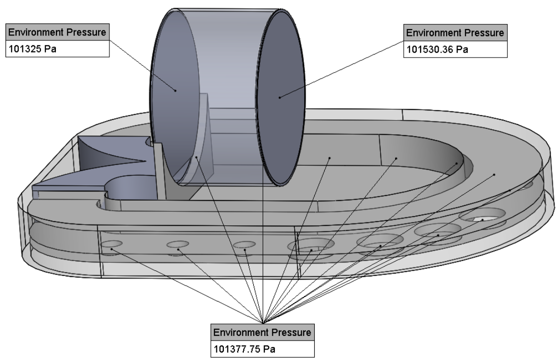



Figure 7: **Hovercraft design refinement.**

What: Refined preliminary design to verify performance and safety.

How: Analytical and numerical evaluations, trade studies, requirement traceability.

Results: Viable design space narrowed; critical parameters verified against requirements.

Engineering Focus: System-level analysis, design verification, requirement traceability.

Structural Stress Analysis & Design Optimization — Beams and Trusses- Mech 3502(Stress Analysis)

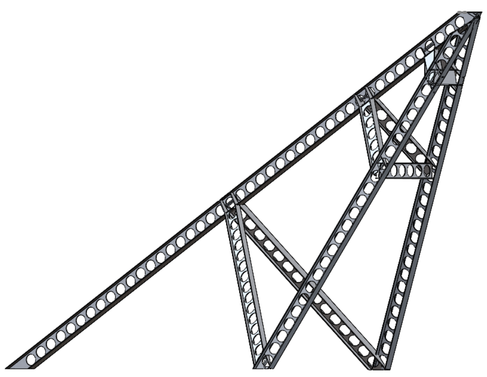
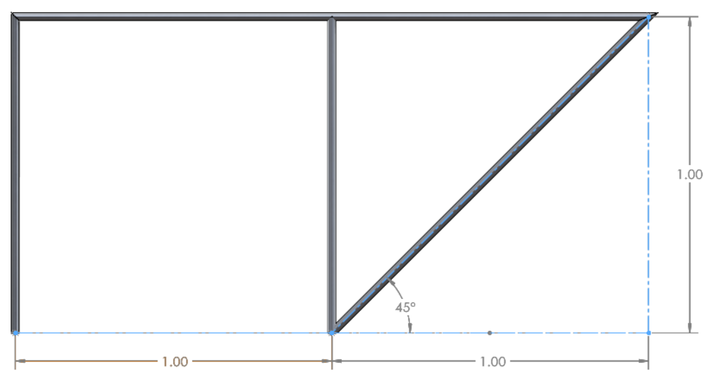



Figure 8: **Stress and internal force analysis of beam and truss systems.**

What: Optimized beams and trusses for material efficiency.

How: Classical mechanics, free-body diagrams, iterative design optimization.

Results: Critical members identified; optimized dimensions improved material efficiency.

Engineering Focus: Structural analysis, mechanics of materials, optimization.

UV Water Purification Tank — CFD-Based Fluids Design- Mech 3492 (Fluid Dynamics)

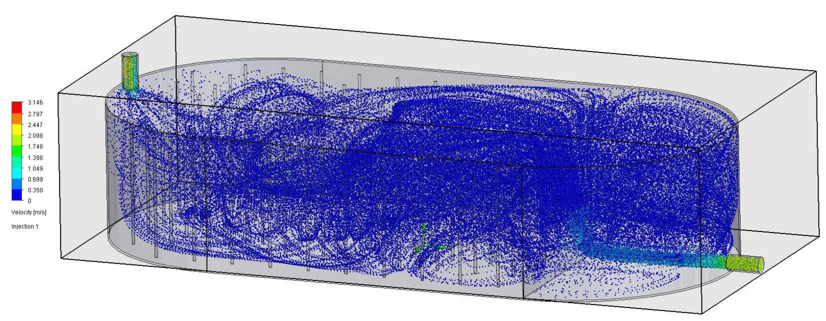
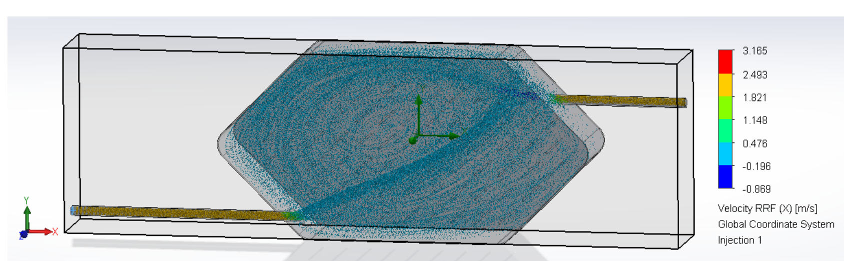



Figure 9: **UV purification tank geometry and particle residence-time analysis.**

What: Designed UV water purification tank for Mars base; ensured minimum 400s particle exposure.

How: CFD modeling and particle tracking; geometry optimized to reduce vortices and improve flow uniformity.

Results: Achieved 558.6s average residence time; compact tank volume 8.4 m^3.

Engineering Focus: CFD, flow uniformity, residence-time optimization.

Tools, Methods, and Standards

Software

SolidWorks, Ansys, Xfoil, Maple, Oracle, e-builder, Capp, AutoCAD, Microsoft Office, MATLAB, Simulink, Python, LaTeX

Engineering Methods

- Model-Based Systems Engineering (MBSE)
- Trade Studies and Sensitivity Analysis
- Failure Modes and Effects Analysis (FMEA)
- Verification and Validation (V&V)

Standards (Familiarity)

- NASA Systems Engineering Handbook
- MIL-STD-499 / 881
- DO-178 (Awareness)