MATLAB Aircraft Sizing Code

This is an aircraft sizing code for estimating component and fuel weights for a conventional jet transporter aircraft. The code is comprised of the following main modules:

1) Input file and main run-file (runMASC.m)
    i) Function calls
        (1) Main sizing routine (SizingIterations.m)
        (2) Economic mission analysis (EconMissionFunction.m)
        (3) Performance analysis (PerformanceFunction.m)
        (4) Acquisition cost estimation (AcquisitionCostFunction.m)
        (5) Operating cost estimation (OperatingCostFunction.m)
        (6) Display of results (ReportFunction.m)

2) Main sizing routine (SizingIterations.m)
    i) Cabin layout generation routine (LayoutFunction.m)
    ii) Geometry analysis routine (GeometryFunction.m)
    iii) Empty weight estimation routine (EmptyWeightFunction.m)
    iv) Warm-up and takeoff analysis routine (WarmupTakeoffFunction.m)
    v) Climb analysis routine (ClimbFunction.m)
    vi) Cruise analysis routine (CruiseFunction.m)
    vii) Loiter analysis routine (LoiterFunction.m)
    viii)   Landing and taxi analysis routine (LandingTaxiFunction.m)

3) Economic mission analysis (EconMissionFunction.m)

4) Aircraft performance analysis (PerformanceFunction.m)
    i) Takeoff performance analysis
    ii) Envelope performance analysis routine (to be developed)

5) Aircraft cost analysis
    i) Acquisition cost analysis routine (AcquisitionCostFunction.m)
    ii) Operating cost analysis routine (OperatingCostFunction.m)

6) Results reporting (ReportFunction.m)
    i) Tabular description of aircraft weights (empty, payload, fuel)
    ii) Graphical description of aircraft (to be developed)

What follows is a description of each module and accompanying functions and sub-functions along with sources of information and assumptions.

1. Input file and main run-file (runMASC.m)
This file allows the user to input fixed parameters to be used by the routine. These fall under the following categories:

      a. Mission parameters
      b. Performance parameters
      c. Geometry parameters
      d. Aerodynamic parameters
      e. Propulsion parameters
      f. Payload parameters

These parameters are aggregated into an input structure that is used by all the sub-functions.
Note that some sub-functions contain additional fixed parameters that can be changed, but that are specific to that sub-function.

2. Main sizing routine (SizingIterations.m)
This is the main function that sizes the aircraft. It is set up as an iterative loop that uses an initial guess for the aircraft takeoff gross weight (TOGW) and convergence tolerance to determine the TOGW of the aircraft.

First, the cabin layout is determined based on the fixed parameters in the LayoutFunction.m file. Then the aircraft geometry is determined based on the input parameters in the runMASC.m file and the output of the cabin layout analysis. Next, the aircraft empty weight is estimated by EmptyWeightFunction.m. After the empty weight is estimated a series of function calls determine the fuel weight fractions for each mission segment:

      a. Warm-up and takeoff
      b. Climb
      c. Cruise (constant altitude and Mach number)
      d. Loiter
      e. Landing and taxi

The cruise and loiter segments are the only mission segments that have actual fuel weight estimations. The other segments (and corresponding functions) use a fixed fuel weight fraction based on historical data. If more accurate estimation is desired, these functions can be modified to incorporate the desired methodology. Additionally, if additional mission segments are desired additional functions must be created and appropriately placed in this file.

3. Economic mission analysis (EconMissionFunction.m)
This function is essentially the same as the main sizing routine and it uses the same sub-functions. It "sizes" an aircraft to compute the fuel weight for the given payload and range values. The only difference is that it does not contain an empty weight estimation routine. The empty weight of the aircraft is determined during the main sizing routine and is not changed here. Changes to the main sizing routing that involve the addition or incorporation of additional functions should also be made to this function. The output of this function is the fuel weight required to perform the mission and the takeoff gross weight of the aircraft. These results will be used by the cost sub-functions to determine the operating cost of the aircraft.

4. Aircraft performance analysis (PerformanceFunction.m)
This function currently performs a takeoff analysis; it determines the takeoff distance based on C_{Lmax} and the takeoff parameter

5. Aircraft cost analysis
NOTE: The cost prediction parameters uses equations applicable for transport/commercial passenger transport aircraft. Equations need to be modified for other aircraft designs/studies.
Acquisition cost analysis routine (AcquisitionCostFunction.m)
This function estimates the acquisition cost of the aircraft based on its takeoff gross weight and other fixed parameters embedded in the function.
Operating cost analysis routine (OperatingCostFunction.m)
This function estimates the operating cost of the aircraft based on its acquisition price, the mission fuel, and other fixed parameters embedded in the function.