abstract

Standard procedures to estimate en-route aircraft performance rely upon the “standard atmosphere”. Real-world conditions are then represented as deviations from the standard atmosphere. Both flight manuals and aircraft designers make heavy use of the “deviation method” to account for geographical and temperature differences in atmospheric conditions. This method is often done statically, choosing a single deviation based on temperature and a single wind speed for the duration of an entire mission. Real-world atmospheric conditions have an incredible amount of variation throughout any given flight route, however. Changes in geographic location can present many changes within the atmosphere; they include differences in air temperature, humidity, wind speeds, wind directions, air densities, and more. Historically, these changes have not been accounted for in standard mission performance models. However, they present major possible impacts on real missions. This thesis addresses this issue by developing a lateral and vertical mission simulation method that uses real-world and up-to-date atmospheric conditions to determine the effect of changing atmospheric conditions on en-route performance and economy. The custom toolset was used in combination with a series of trades over a series of five days and a representation of each season to show the variation that occurs on a single route over the course of daily and seasonal periods. Both qualitative and quantitative effects from this perspective were recorded for the Airbus A320 and a student designed regional jet, the Aeris, to determine the effect of atmospheric variation on standard commercial transport and hypothetical high-altitude capable commercial transport. The variance presented by changing atmospheric conditions is massive and has large implications on future aircraft operations and design. Due to large geographical and temporal variation in the wind speeds and directions, it is recommended that aircraft operators use daily measurements of atmospheric conditions to determine optimal flight paths and altitudes. Further investigation is recommended in terms of the effect of changing atmosphere for design, however from initial investigations it appears that a statistical method works well for incorporating the large variance added by real-world conditions.