Sonic Boom Research: TsAGI Approach

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Due to sonic boom concern the supersonic flights are prohibited over the most populated areas. Development of future generation supersonic transport and ongoing space launch activity support interest in continuing sonic boom research. Since the flight experiment is expensive way of analysis and ground test facility does not provide full similarity in sonic boom modeling the numerical methods are the main tools in sonic boom analysis.

TsAGI has been involved in sonic boom theoretical, numerical and experimental research since 1960s. It was Prof. Zhilin who developed theory for calculating sonic boom from aircraft, flying along arbitrary trajectory with three-dimensional non-homogeneities of atmosphere. On a base of this theory the computational method of sonic boom analysis in stratified non-homogeneous atmosphere with three-dimensional wind has been developed. Computer code calculates pressure signature and ray paths both for primary and secondary sonic boom areas. It provides calculation of the sonic boom exposure areas on the ground including focusing boom, superboom, and secondary sonic boom areas.

The near field pressure distribution is used for F-function calculation on a base of panel methods or Euler equation solutions without introducing concept of equivalent body of revolution. This approach gives higher accuracy of sonic boom calculation in compared with regular quasi-linear Whitham based calculation technique.

Effects of aerodynamic configuration, flight trajectory, and atmospheric conditions on sonic boom have been investigated. Various aircraft geometry parameters, flight maneuvers, weather conditions have been considered in a sonic boom analysis.

Minimum boom concept and the main trends in SST sonic boom reduction have

been investigated. Computer code for the minimizing sonic boom due to aircraft geometry change has been developed. There are several low boom SST configurations, developed in accordance with this minimizing procedure.

Presented paper provides review of mentioned above TsAGI results in sonic boom prediction technique, analysis, and minimization. Most attention has been given to the recent results.