D-SEND Project Team

Having been recently established to focus on the flight demonstration of “low sonic boom design technology” (considered a high priority as environmentally compatible technology in the “research and development of silent supersonic technology”, which the Supersonic Transport Team has performed up to now), this team is conducting the “Drop test for Simplified Evaluation of Non-symmetrically Distributed sonic boom” (D-SEND) project. The main activity of the team consists in developing the equipment and facilities (such as test pieces to be dropped and the aerial boom measurement system) necessary for the flight test as well as performing the drop tests.

Project Details

1. Project profile

The D-SEND project is composed of drop tests D-SEND #1 and D-SEND #2. In the D-SEND #1 drop test, two different axisymmetric bodies are dropped from an aerial blimp and the sonic booms are measured and compared with each other. In the D-SEND #2 drop test, an experimental supersonic airplane (unmanned aircraft with no engine and capable of autonomous flight) designed utilizing JAXA’s proprietary low sonic boom design technology is dropped and the sonic boom is measured. The sonic booms are measured and recorded by the microphone system that has been set up in a line between the ground and the blimp (altitude of 1 km). These drop tests will take place at the Esrange Test Site near Kiruna in Sweden.

2. D-SEND #1 drop test

In D-SEND #1, two test bodies (the NWM (N-Wave Model), which generates the pressure signature of an N wave, and the LBM (Low-Boom Model), which generates the pressure signature of a low-boom wave) are dropped consecutively at a 10-second interval from a balloon at an altitude of 30 km. Both bodies reach a maximum Mach number of 1.8 and generate sonic booms forward and perpendicular to the Mach cone angle. The sonic booms are measured by a boom measurement system. Information such as velocity (speed) and position data of the drop test models are transmitted to the ground by the telemetry system.

This test was performed twice in May 2011, and the following is a list of what we were able to achieve.

1. Establish boom measurement technology with axisymmetric test models
2. Confirm the feasibility of low-boom wave measurement
   (by comparing the N-wave model to the low-boom model)
3. Perform preliminary testing for D-SEND #2
   (test familiarization, confirmation of measurement method, etc.)

Drop test body

Balloon launch preparations

Sonic boom waveform
Goals
The goal is to show, through flight tests, the feasibility of the "low sonic boom design concept", where JAXA has the technical advantage in environmentally compatible technology over the rest of the world, and to obtain an aerial boom measurement method that would be able to contribute to an international standard assessment of sonic booms for the next-generation supersonic transport that is currently being examined.

3. D-SEND #2 drop test

For D-SEND #2, the S-cube Concept Model, designed using JAXA’s proprietary low-boom design technology for a low sonic boom at the front and end of the fuselage, is dropped from a balloon at an altitude of 30 km and glides over the boom measurement systems at Mach 1.3 and a flight-path angle of 50 degrees, where the generated boom signature goes down vertically toward the systems. The sonic boom is measured by a series of boom measurement systems held at an altitude of 1 km.

With D-SEND #2, we aim to achieve the following goals.
1. Demonstrate the effect of low sonic boom design at the front and end of the fuselage
2. Establish low-boom wave acquisition technology
3. Verify the low-boom propagation analysis technology

4. Boom measurement system (BMS)

The blimp is held at an altitude of 1 km in order to measure the influence of turbulence near the ground on the sonic boom, and low-frequency microphones are installed at several points between the blimp and the ground. In addition, multiple microphones are arranged on the ground.

Plan

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