SIMULATION INTEGRATION

(F I) B D L T I E D M D D R P I 737 S 737-10

PHOTO: LIZ OLTER/BOEING

Dutch rolls are caused by any asymmetric input, such as wind or pilot commands, causing a series of oscillations that will continue until the movement xes itself or the pilot corrects it. This phenomenon is important for engineers to study in simulations and ight tests.

Perfecting Imperfection: Intentionally Designing Dutch Rolls

“We intentionally stir up large Dutch rolls to gather data to update the aerodynamic model and safety margins,” said Darren McDonald, a Boeing Technical Fellow and ight test engineer. “But the oscillations have to be perfectly formed for us to get the information we need.”

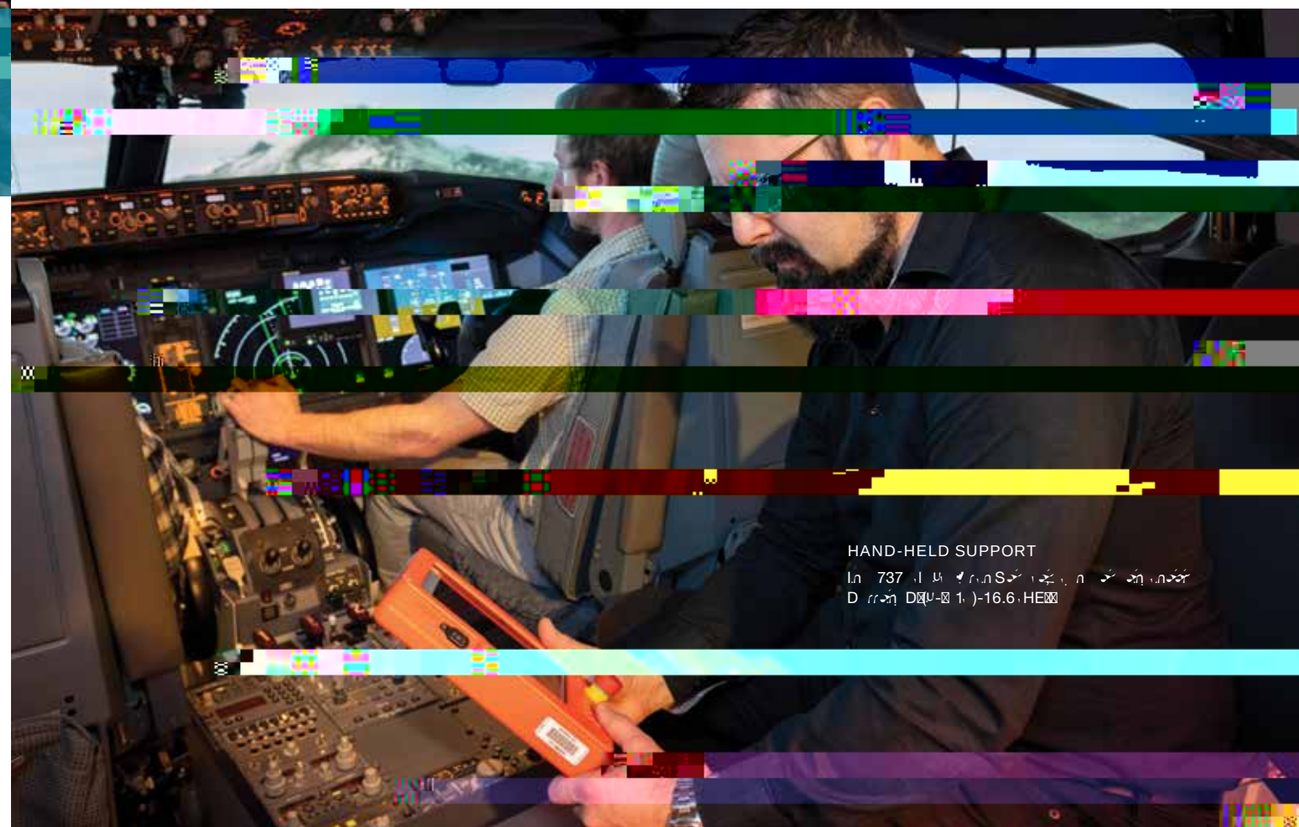
To create these perfect Dutch rolls that can be initiated both in simulations and during real flight tests, Boeing Test & Evaluation’s Flight Test Engineering team based at Seattle’s North Boeing Field created the Dutch Roll Initiator (DRI) in 2019. Engineers first deconstructed the maneuver and then moved to desktop and piloted simulations before flying for two days in November 2021 onboard a Boeing 737-10.

“We learned which parameters de ne a quality maneuver then studied how to effect the most predictable, highest-quality maneuver,” said ight test engineer Jordan String eld. “We conducted trade studies with the desktop simulator and talked with the design engineers who require the data.”

Simulation and Validation: Going Beyond Compliance

The team used engineering simulators throughout project development, testing and training. They introduced the rudder actuation signals to start a Dutch roll through most of the same hardware that is used on the 737-10. They also performed end-to-end validation and crew training on the system before boarding the airplane.

The DRI commands a carefully timed rudder input in one direction and then an identical rudder input in the opposite direction at a rate that matches the airplane’s natural response frequency. The precise symmetry required for the maneuver is difficult to perform manually, especially when paired with aircraft structural limitations.



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