Dynamic Inertia Measurement Method (DIMM)

DFRC
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Inertia Testing Background

- Conventional Methods used for decades
  - Pendulum and Knife Edge Methods
  - High risk to aircraft during critical lifts and test setup
  - Require large testing crews and massive test fixtures
  - Consume a lot of time and money
  - Measurement uncertainty not well evaluated, quantified, or documented

- Benefits of DIMM
  - One configuration is capable of providing the full mass matrix
  - Little additional effort required beyond GVT
    - Same data type used (frequency response functions)
    - GVT instrumentation, data acquisition, and excitation
    - GVT Soft Suspension System
    - Additional DIMM instrumentation required:
      - Seismic accelerometers – for higher sensitivity
      - 6-dof load cells at soft suspension system interface points
      - Laser tracker to record DIMM instrumentation orientation
Research Approach

• Validated DIMM against conventional methods
  – Built two test articles (4,000 lbs and 17,000 lbs)
  – Measured X-cg and yaw-inertia using bifilar pendulum
  – Measured all mass props with DIMM
    • Compared x-cg and Izz to bifilar

• Evaluated DIMM test methods on large test articles
  – Sensors
    • Seismic accelerometers
    • 6 degree-of-freedom load cells
  – Excitation techniques
    • Impact hammer vs. shaker excitation
    • Force levels
    • Excitation locations
  – Data collection techniques
Conclusions

• Several key questions were answered in regards to excitation and instrumentation.
  – Excitation method that renders best DIMM data
  – Seismic accelerometers provided good DIMM response
  – Good sensor coverage of lowest flexible modes is a must for successful use of spatial filtering

• Some aspects need further consideration for DIMM application on large test articles
  – A different 6 degree-of-freedom load cell design should be considered
  – Spatial filtering requires adequate instrumentation to fully measure first flexible modes
  – Care should be taken to anticipate/measure non-structural component modes lower than first flexible mode

• Future Testing
  – The pedestal modes interfered with DIMM analysis. Repeat of testing on a soft support system without the pedestals would increase the frequency range where DIMM analysis can be performed and increase confidence in results.
  – A repeat of bifilar testing is also being considered since the DIMM configuration of the test article did not exactly match the bifilar configuration.