



NASA Bird Strike Research



J. Michael Pereira
NASA Glenn Research Center



Objectives

- Ensure the safety of Advanced Air Mobility vehicles in bird strike events

Approach

- Develop and validate computational models to simulate bird impact on composite structures
 - Enable efficient and safe designs
- Develop methods to qualify an artificial bird for development and certification testing



Background

- CAAs requires real bird testing for certification of aircraft structures such as leading edges, transparencies and engines
- The type of bird is not specified. Companies use chickens, pheasants, ducks and other species
- Problems with real bird testing
 - Unhygienic
 - Difficult to procure birds of the correct mass at different times of the year
 - Requires animal euthanizing
 - Highly non-repeatable results
- An artificial bird would improve repeatability and reduce modeling complexities



Certification Testing Observations

- Birds are usually contained in a bag of some kind when they're launched at the target
- The type of bag is not specified
- There is only one standard that discusses how birds must be prepared for testing (ASTM F330-21)
 - The preparation allows for trimming of parts of an overweight bird or injecting water or gelatin to an underweight bird

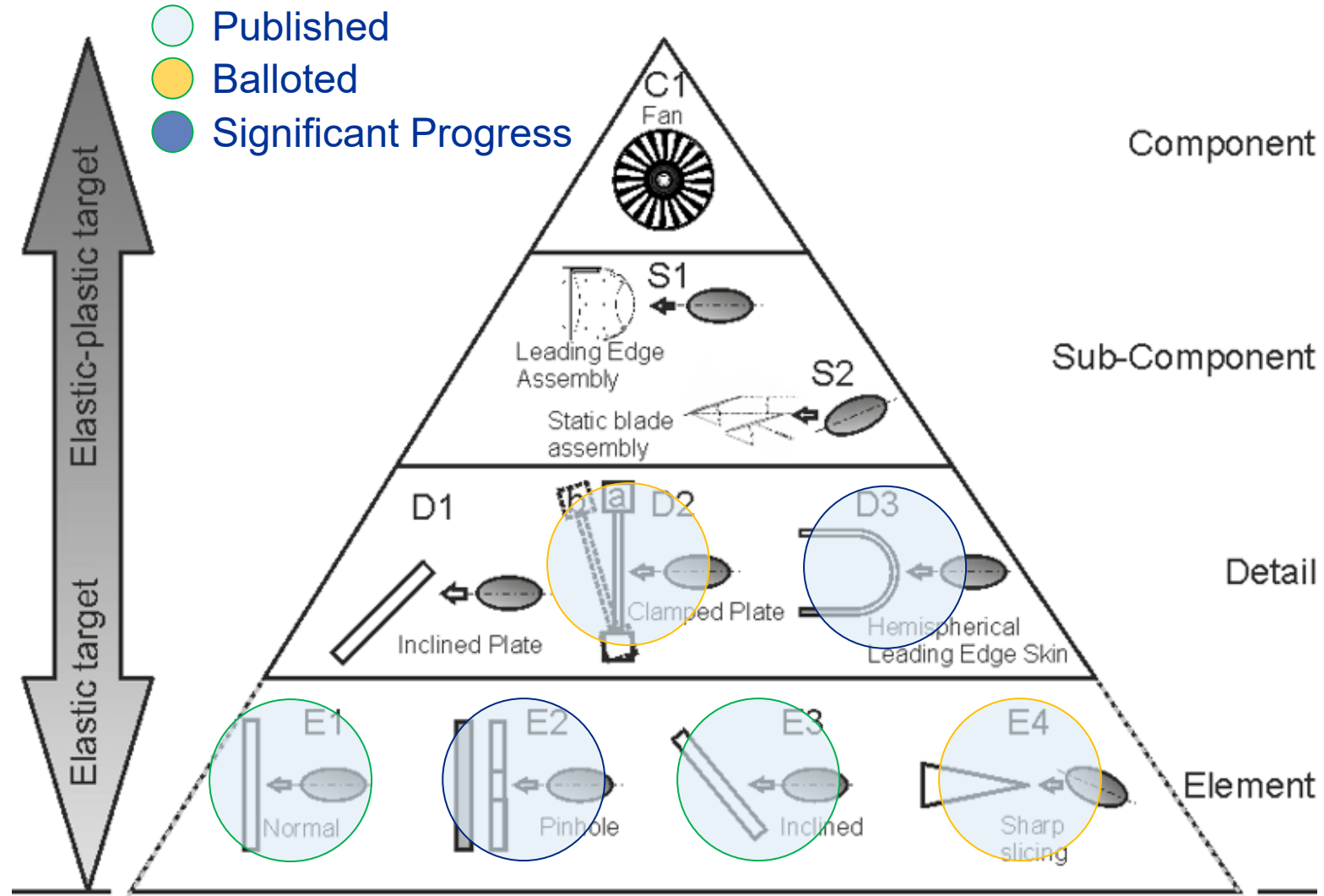




Approach to Artificial Bird Development

- An SAE committee was formed with the objective of collaboration between industry, universities, research organizations and CAAs to develop an artificial bird
- SAE G-28: Simulants for Impact and Ingestion Testing Committee
 - Purpose: develop standards that may be used to compare the damage threat posed by real birds and surrogates
 - It is the responsibility of the applicant to demonstrate equivalence to the CAA of its surrogate and the real bird
- NASA:
 - Initial formulation of the committee
 - Committee Secretary

SAE G-28 Proposed Tests



Artificial Bird Testing. Test E1.



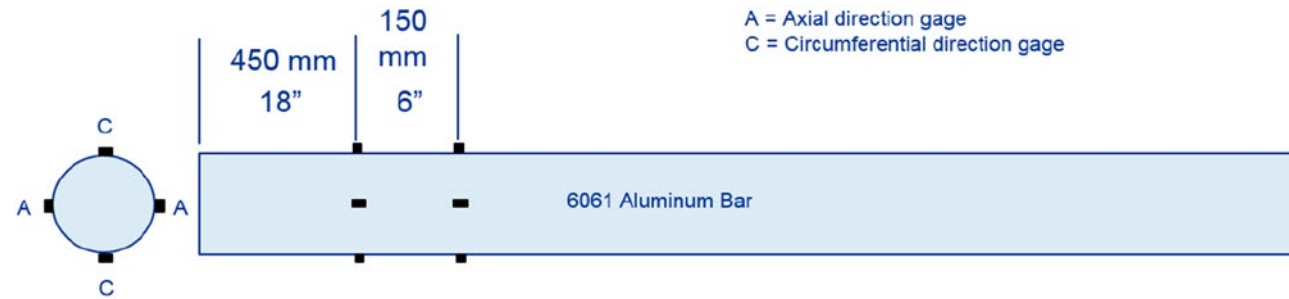
UDRI Bird



DLR Bird

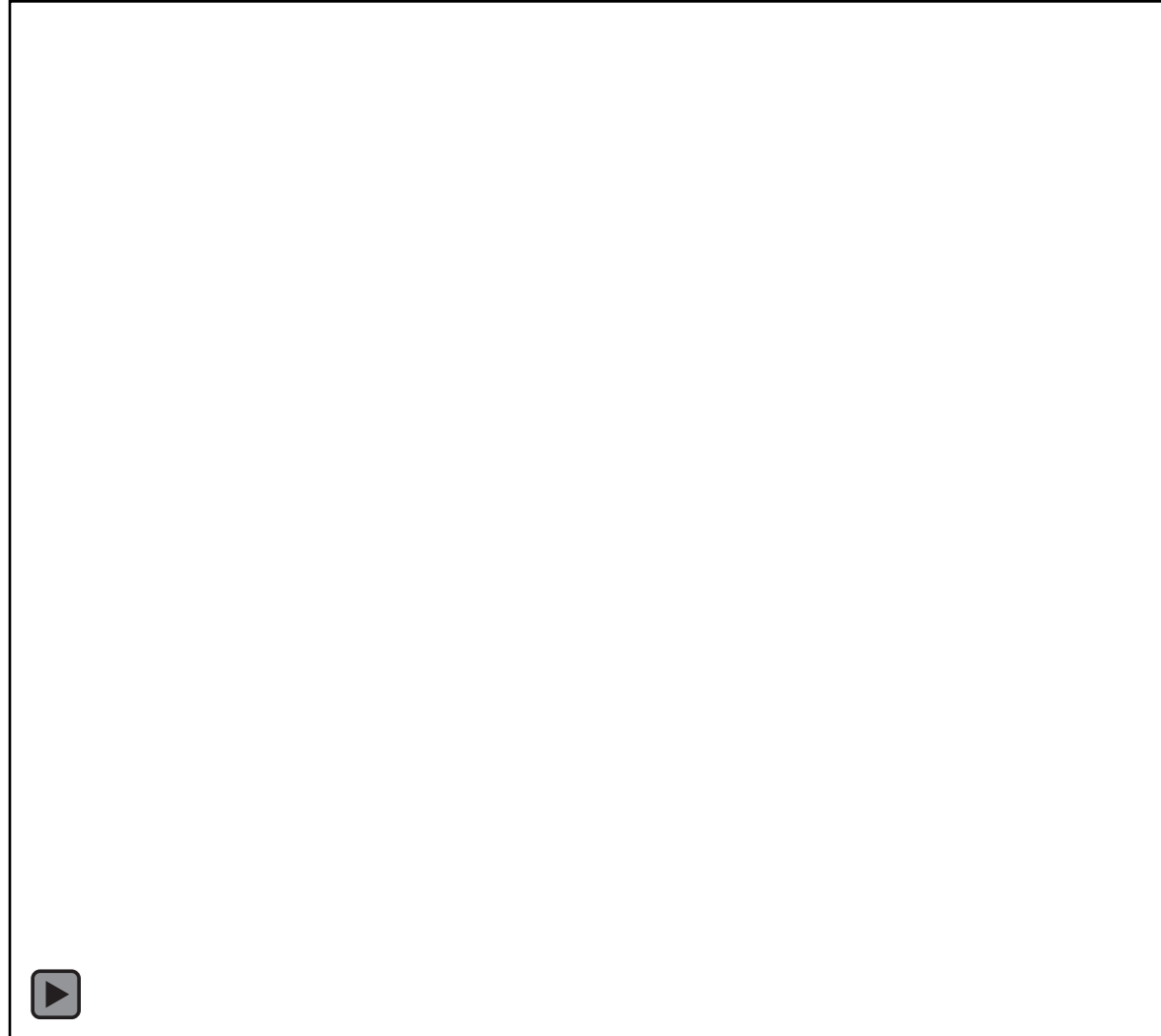
Gelatin/phenolic micro-balloon mixture

Test Setup



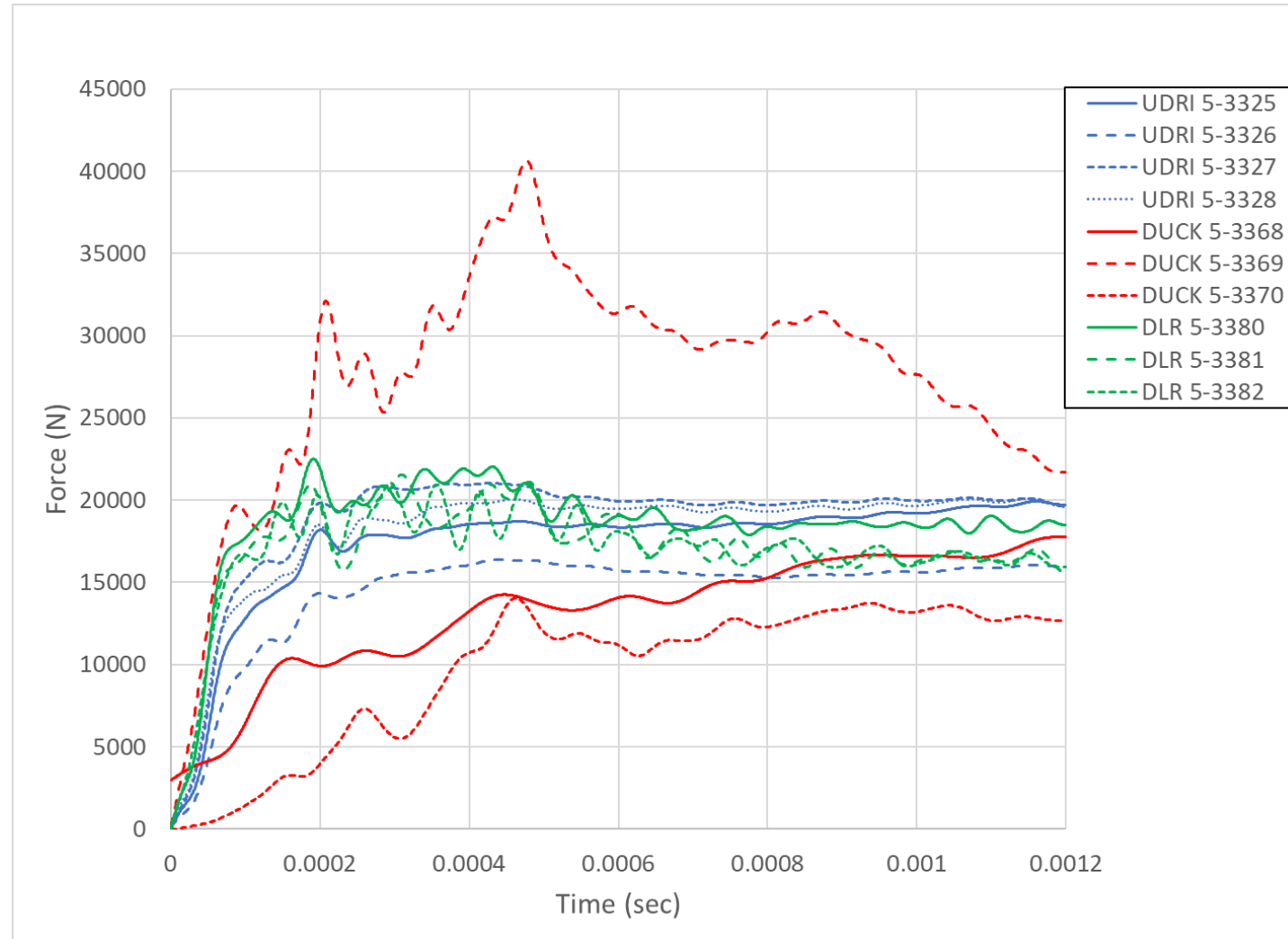


Test 5-3331. 110 m/sec Gelatin Impact





Impact force from 1 kg projectiles at an impact velocity of 49 m/sec





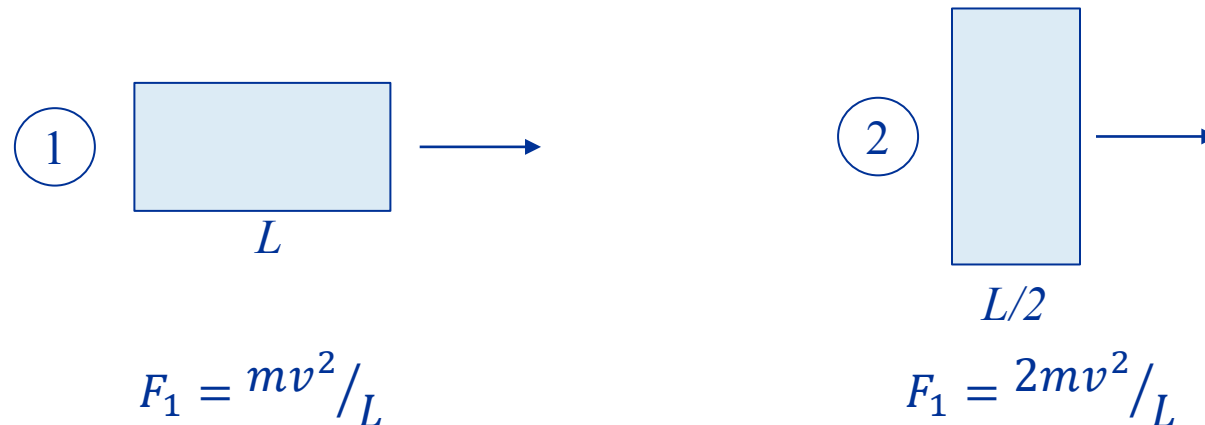
Effect of Orientation

Consider two scenarios. Assume $L/D = 2$ and same mass and velocity:

1. Projectile impacts longitudinally
2. Projectile rotates and hits flat

$$mv = \int F dt \sim F_c \Delta T = F_c L/v$$

$$F_c = mv^2/L$$



Orientation has a significant effect on impact force



UDRI Bird 310 m/sec



More Recent Artificial Bird Concepts

- Crash Test Services
- NASA Artificial Bird





Planned Activities

- Continue development of standards to qualify an artificial bird
- Conduct testing as funding is available
- Continue validation of bird impact models



DLR

**Deutsches Zentrum
für Luft- und Raumfahrt**

German Aerospace Center

Institute of Structures and Design
Stuttgart, Germany





Platforms and Discussion

- **Active Participants**

- Platform: MS Teams
- Discussion: MS Teams microphone, chat, and “Raise your hand” functions
 - All questions and feedback will be taken at the designated *General Discussion* timeframe.
 - Leave your cameras/webcams off to preserve WiFi bandwidth
 - Use your mute/unmute button (e.g., remain on mute unless you are speaking)
 - Enter comments/questions in the chat
 - Click the “Raise your hand” button if you wish to speak
 - Say your name and affiliation before you begin speaking

- **Listen Only Participants**

- Platform: YouTube Live Stream
 - Go to <https://nari.arc.nasa.gov/aam-portal/> for the link
- Discussion: Conferences IO
 - Enter <https://arc.cnf.io/sessions/twfz/#!/dashboard> into your browser
 - Questions will be addressed *if times permits or at the facilitator’s discretion*



Don't want to type in the link for Conferences IO?
Scan the QR code!