Will it Float?
Predicting Aircraft Buoyancy

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US Airways Flight 1549

January 15th, 2009 Flight 1549 took off from LaGuardia Airport, struck a flock of geese, and lost engine power.

Pilots Chesley Sullenberger and Jeffrey Skiles ditched in the Hudson River. All 155 people aboard were rescued.

"Miracle on the Hudson" was described as "the most successful ditching in aviation history"

[NTSB Animation Flight 1549 Hudson River Landing US Airways](#)

14 CFR 25.801

(d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the airplane and enter the liferafts required by §25.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the airplane has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.

Problem Definition

How much time passes until the exits are underwater or the angle is too steep for escape?

Prerequisites:

- Airplane position and angle relative to the water
- Location of any openings that can allow water in
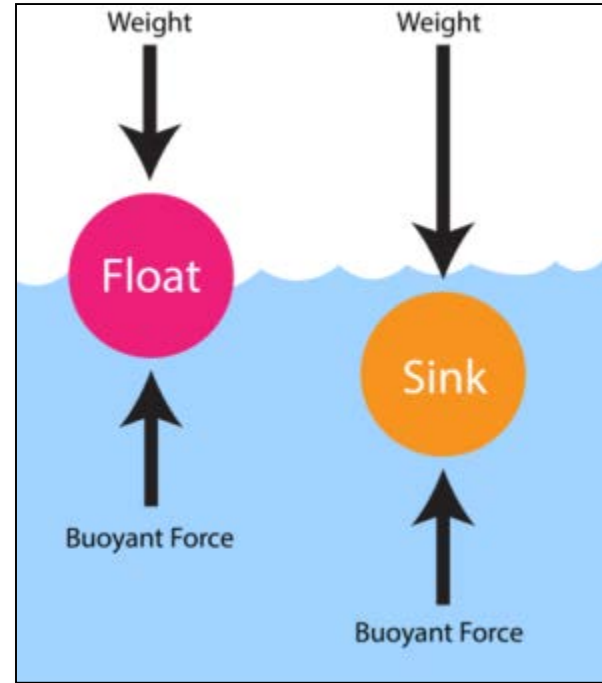- A method of determining change in position and angle as water floods the aircraft

Buoyancy Basics

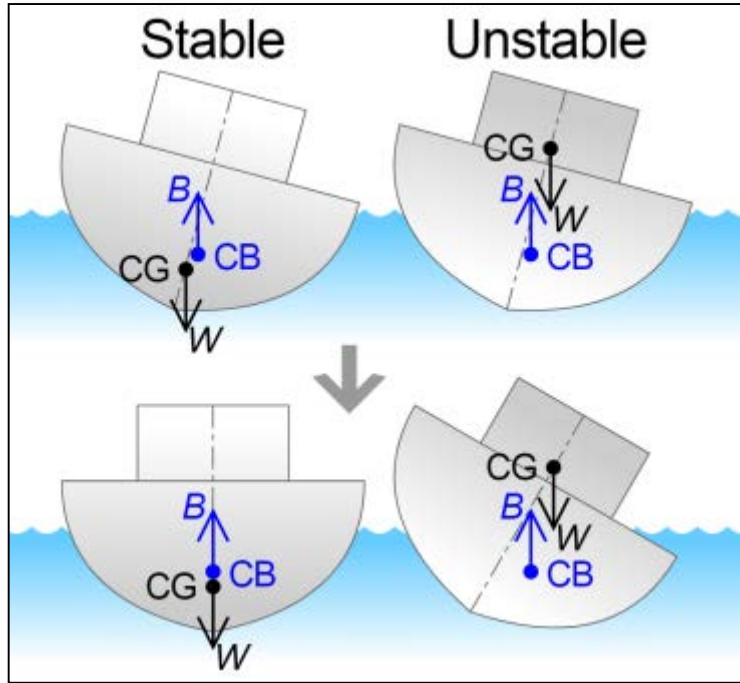**Buoyant force** - upward force exerted by a fluid opposing the weight of an immersed object

• As pressure increases with depth, so does the buoyant force

As an aircraft fills with water, its weight increases.

When the weight exceeds the buoyant force, it sinks.

Buoyancy Basics

Center of gravity (CG) - the point in a body at which the whole mass may be considered as concentrated

Center of buoyancy (CB) - center of gravity of the displaced water

Hydrostatic stability - the tendency of a floating vessel to return to its at-rest attitude
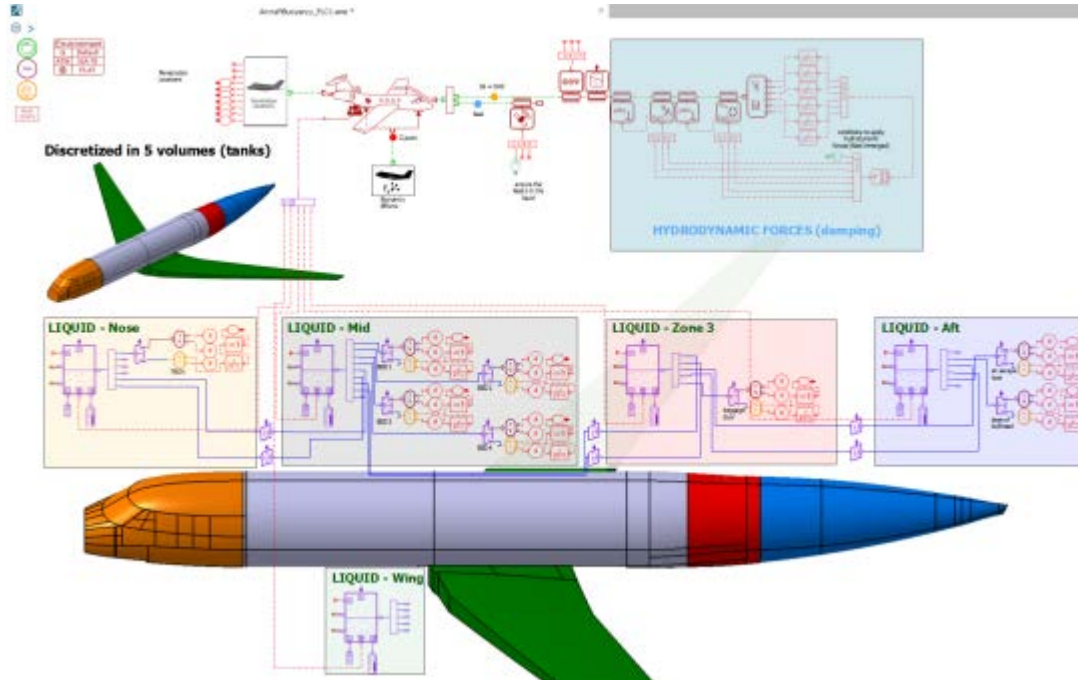
Method Comparison

Excel spreadsheet solver

- Simple geometry
- Simple hull penetrations
- Idealized physics
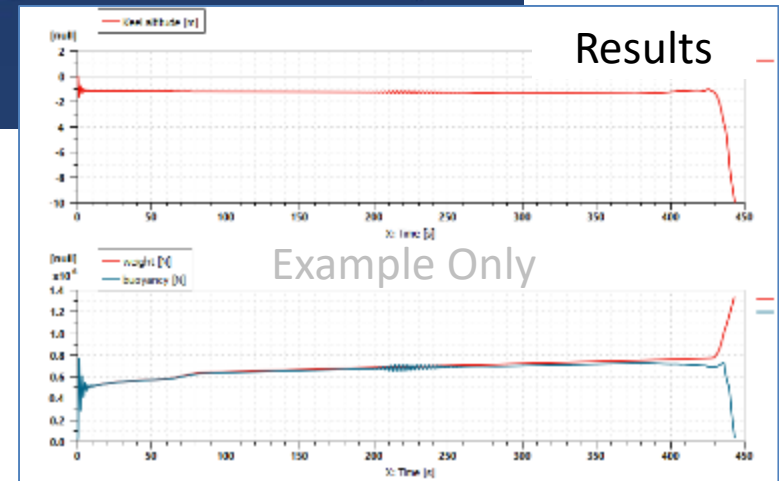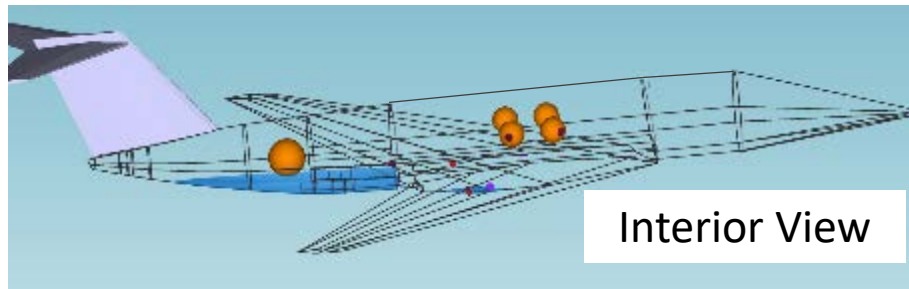- Inconsistent results

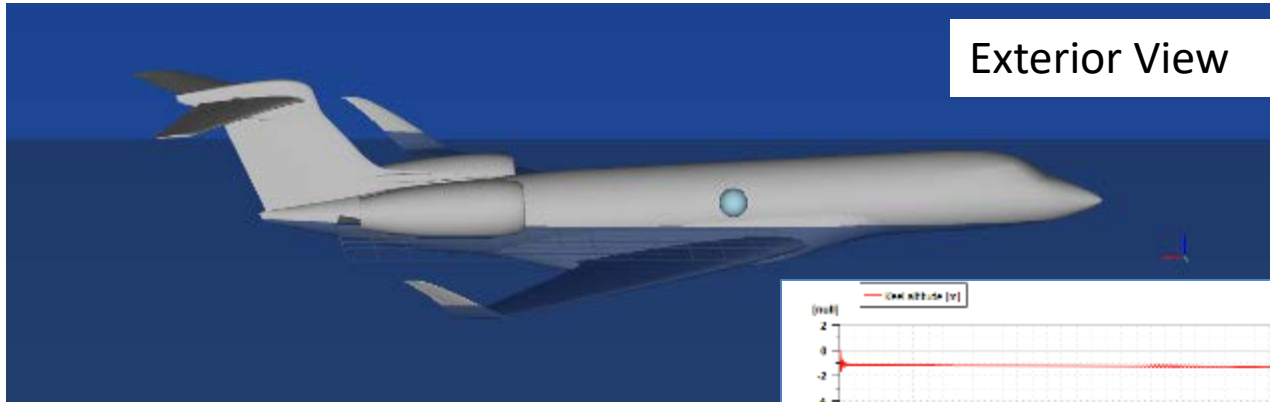**Simcenter Amesim**

- CAD import
- Complex penetrations
- Complex physics simulation
- Repeatable results

Simcenter Amesim

Predicting Aircraft Buoyancy

Simcenter Amesim – Demo

Exterior View

Interior View

Results

Example Only
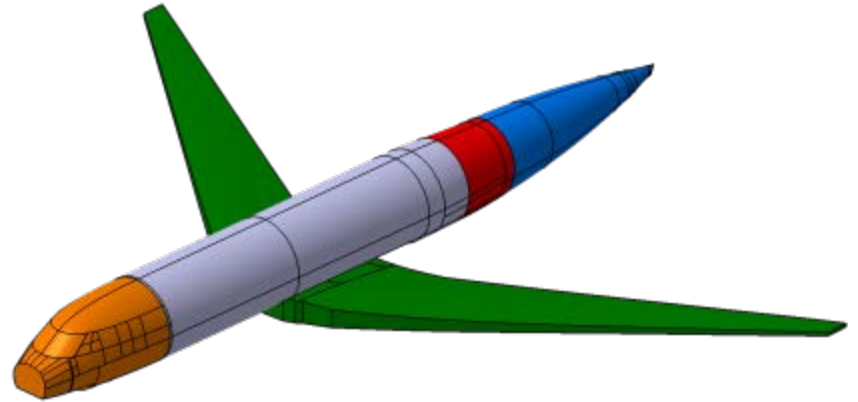
Next Steps

- Refine model

- Validate simulation

- Determine specific desired outputs

- Get method approved by the
  Aircraft Certification Office (ACO)

- Document the process of adapting
  the simulation for other aircraft

Questions?