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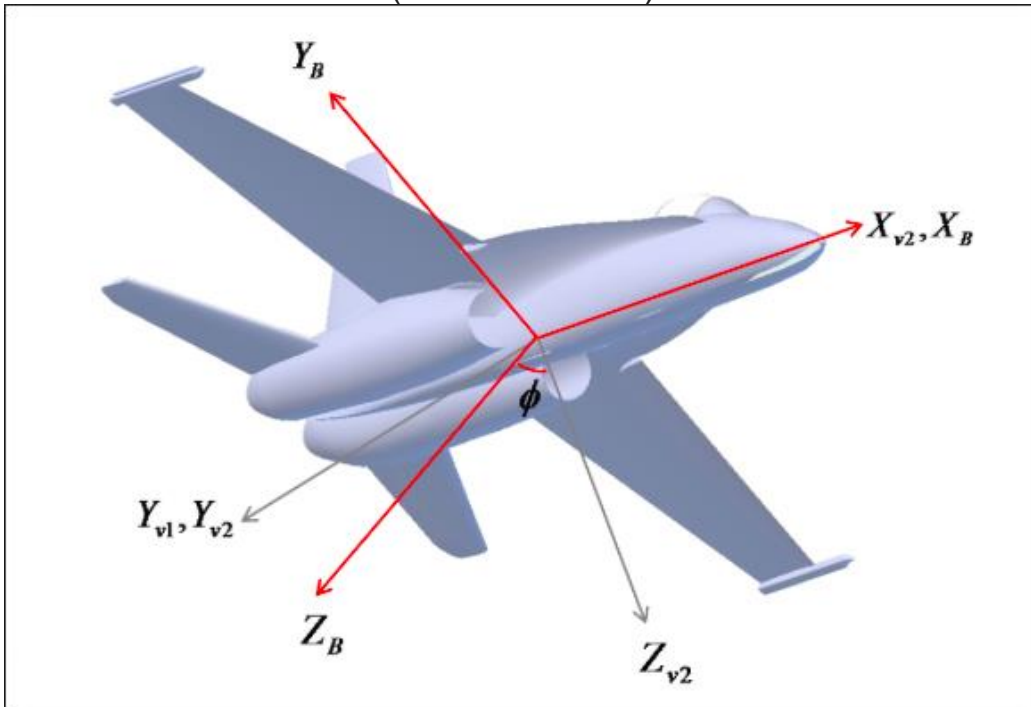
Simulators via 4-dimensional geometry

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Abstract:

The complex numbers provide a rich algebraic structure on vectors in the ordinary plane, where multiplication has geometric meaning in terms of rotations. In 3-dimensional space there is nothing comparable (the vector cross product has poor properties).

But in 4-dimensional space there is a remarkable way to ``multiply'' vectors. It can be used to do many interesting things such as: prove that every positive integer is a sum of 4 perfect squares, perform smooth rotation in video games and flight simulators, and show that when you spin around by 360 degrees you might not be back where you began.

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