

ILLIWII:
A FRIENDLY FORAY INTO
FRUGAL FLYING

BY YOST SMITH

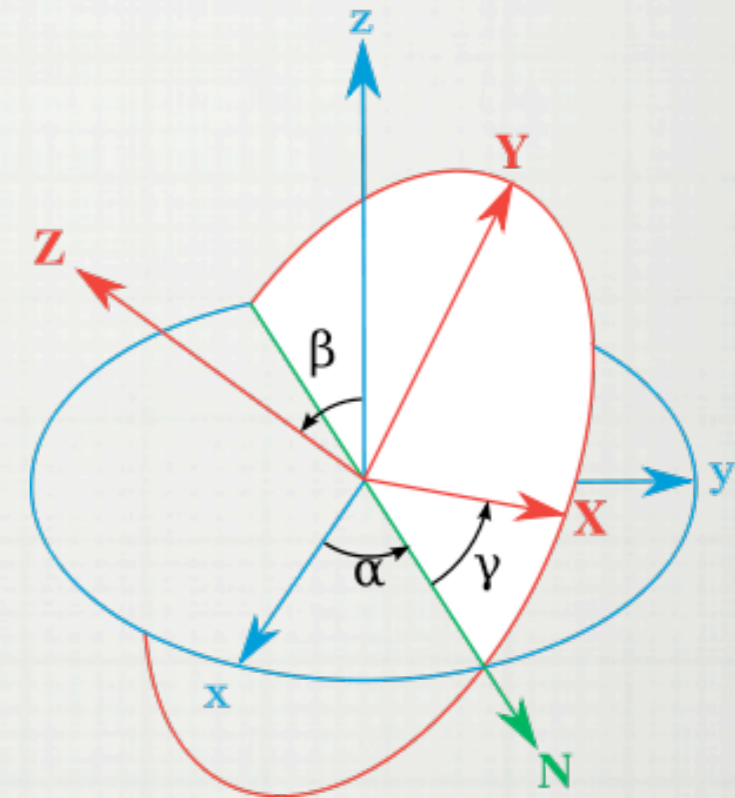
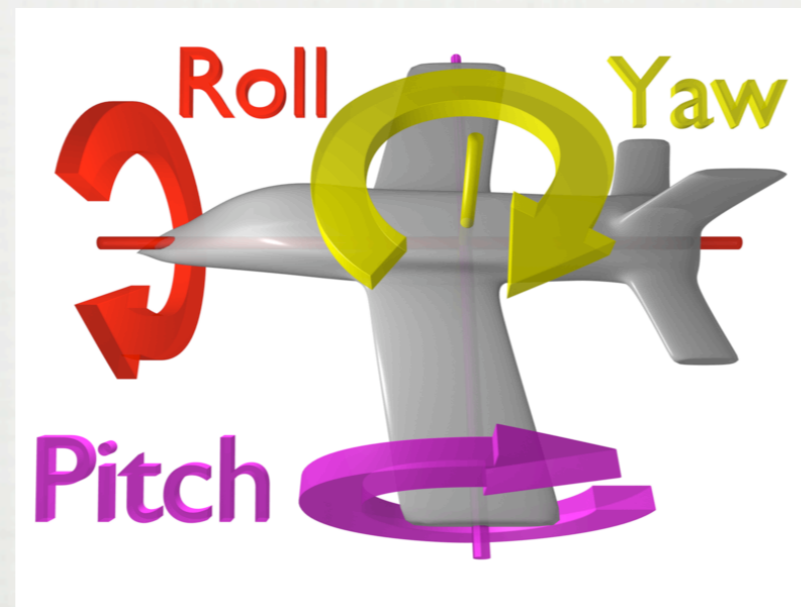
OBJECTIVES OF THE PRESENTATION

- TO EXPLAIN THE BASICS OF CONTROL SYSTEMS
- TO EXPLAIN THE BASICS OF A ROTATION MATRIX
- TO EXPLAIN THE BASICS OF PFORTH
- TO WALK THROUGH A SAMPLE OF PFORTH CODE
- TO MAINTAIN ABOVE A 3/4 RATIO OF PEOPLE AWAKE TO PEOPLE ASLEEP (>75%)

CONTROL SYSTEMS

- ROLL, PITCH AND YAW
- DEFINED BY EULER ANGLES

$$Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{\sqrt{3}}{2} & \frac{1}{2} \\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}$$



$$Q_z(\theta) = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix},$$

$$Q_x(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix},$$

$$Q_y(\theta) = \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix},$$

THE ROTATION MATRIX

- WHAT HAPPENS WHEN WE WANT MORE THAN ONE ROTATION?
- SIMPLY WHAT RESULTS FROM MULTIPLE ROTATIONS ONE AFTER ANOTHER
- CAN GET TO BE VERY VERY UGLY

NOW WHAT ABOUT TRANSLATION

- TRANSLATION CAN BE ADDED TO THIS BY USING A 4X4 INSTEAD OF A 3X3. THE LAST COLUMN WILL BE OUR X, Y, Z TRANSLATION.

| | | | | | | | | |
|---|---|---|--------|---|---|---|---|--------|
| 1 | 0 | 0 | ta_0 | * | 1 | 0 | 0 | tb_0 |
| 0 | 1 | 0 | ta_1 | | 0 | 1 | 0 | tb_1 |
| 0 | 0 | 1 | ta_2 | | 0 | 0 | 1 | tb_2 |
| 0 | 0 | 0 | 1 | | 0 | 0 | 0 | 1 |

| | | | |
|----------------------------|----------------------------|----------------------------|-------------------------------------|
| $1*1 + 0*0 + 0*0 + ta_0*0$ | $1*0 + 0*1 + 0*0 + ta_0*0$ | $1*0 + 0*0 + 0*1 + ta_0*0$ | $1*tb_0 + 0*tb_1 + 0*tb_2 + ta_0*1$ |
| $0*1 + 1*0 + 0*0 + ta_1*0$ | $0*0 + 1*1 + 0*0 + ta_1*0$ | $0*0 + 1*0 + 0*1 + ta_1*0$ | $0*tb_0 + 1*tb_1 + 0*tb_2 + ta_1*1$ |
| $0*1 + 0*0 + 1*0 + ta_2*0$ | $0*0 + 0*1 + 1*0 + ta_2*0$ | $0*0 + 0*0 + 1*1 + ta_2*0$ | $0*tb_0 + 0*tb_1 + 1*tb_2 + ta_2*1$ |
| $0*1 + 0*0 + 0*0 + 1*0$ | $0*0 + 0*1 + 0*0 + 1*0$ | $0*0 + 0*0 + 0*1 + 1*0$ | $0*tb_0 + 0*tb_1 + 0*tb_2 + 1*1$ |

| | | | |
|---|---|---|---------------|
| 1 | 0 | 0 | $tb_0 + ta_0$ |
| 0 | 1 | 0 | $tb_1 + ta_1$ |
| 0 | 0 | 1 | $tb_2 + ta_2$ |
| 0 | 0 | 0 | 1 |

PFORTH

THE STACK

RPN (REVERSE POLISH NOTATION)

MATRICES, VECTORS AND VARIABLES

STANDARD VOCABULARY

PFORTH EXAMPLE: WIIMOTE_RAW

```
<pforth>
  matrix fixHeadMatrix
  0 5 0 fixHeadMatrix translationMatrix
  matrix fixWandMatrix
  0 3.5 -2 fixWandMatrix translationMatrix
  matrix headMatrix
  matrix wandMatrix

  define filter_matrix_0
  headMatrix getCurrentEventMatrix
  fixHeadMatrix headMatrix headMatrix matrixMultiply
  headMatrix setCurrentEventMatrix
  enddef
  define filter_matrix_1
  wandMatrix getCurrentEventMatrix
  fixWandMatrix wandMatrix wandMatrix matrixMultiply
  wandMatrix setCurrentEventMatrix
  enddef
</pforth>
```

DEMONSTRATION

ZNAIL USING
THE WII!

CONCLUSION

- THANKS TO THOSE WHO DIDN'T FALL ASLEEP
- THANKS TO JIM, CAMILLE AND PROFESSOR FRANCIS