請先下載本週上課資料

- [http://www.ym.edu.tw/~cflu](http://www.ym.edu.tw/~cflu)
- 點選左欄 [課程資料] → [MATLAB圖形使用者介面]
- 下載第12週 [上課資料] materials_L12.zip，檔案大小約953KB

本週內容

- 動作分析GUI架構
- 符號運算(Symbolic Calculation)
Motion Capture
- Record 3D coordinates of VICON markers during walking.

Right leg
1 2 3 4 5 6

MotionAna_UI.m
12/18/2014 Lesson 12, Chia-Feng Lu

Framework of MotionAna_UI
- Import raw data
- Display Data
- Define SP
- Analyze Data
- Save dataset
- Export data

Locate a Specific Function
- By searching the proper 'string' or 'style'
- Ctrl + F for quick search
- Please locate the codes of
- Please locate the codes of
- Please locate the codes of
An Exercise

- Try to add an edit uicontrol
- Locate the code section of "Display"
- Adjust the display speed by the string of edit

Projection Point

- Project point A on plane T to the plane F...

Solve A′ (the projection point of A on E)

- The line L pass through point A and is perpendicular to plane T:
  - \( X = x_1 + at \)
  - \( Y = y_1 + bt \)
  - \( Z = z_1 + ct \)
- Replace \( x, y, \) and \( z \) of plane T by the \( (X,Y,Z) \) and solve \( t \)
  - \( a(x_1 + at) + b(y_1 + bt) + c(z_1 + ct) + d = 0 \)
- Substitute \( t \) into L to get the projection point \( A' (x_2, y_2, z_2) \)
MATLAB Symbolic Calculation

- Equation Solving
- Formula manipulation and simplification
- Calculus
- Linear algebra
- Polynomials
- Mathematical functions

Create symbolic objects (**sym**, **syms**)

Symbolic calculation

Declare symbolic objects

- Remember to declare the symbolic objects before use
  - syms a b c x
  - \( f = \text{sym}('a*x^2+b*x+c') \)

Symbolic Calculation: examples

- Equation Solving
  - \( f = \text{sym}('a*x^2+b*x+c') \)
  - \( \text{solve}(f) \)

- Formula manipulation
  - \( f = \text{sym}('a^3+3*a^2*b+3*a*b^2+b^3') \)
  - \( \text{factor}(f) \)

- Calculus
  - \( f = \text{sym}('\sin(x^2)') \)
  - \( \text{diff}(f) \)

MATLAB Symbolic Calculation

- Equation Solving
  - solve, linsolve, equationToMatrix, ...
- Formula manipulation and simplification
  - simplify, coeffs, expand, factor, subs, ...
- Calculus
  - diff, int, divergence, jacobian, laplacian, ...
- Linear algebra
  - det, inv, gradient, svd, eig, rank, ...
- Polynomials
  - minpoly, coeffs
- Mathematical functions
  - help symbolic math toolbox
Solve \( A' \) (the projection point of \( A \) on \( E \))

- The line \( L \) passes through point \( A \) and is perpendicular to plane \( T \):
  - \( X = x_1 + at \)
  - \( Y = y_1 + bt \)
  - \( Z = z_1 + ct \)
- Replace \( x, y, \) and \( z \) of plane \( T \) by \( (X,Y,Z) \) and solve \( t \)
  - \( a(x_1 + at) + b(y_1 + bt) + c(z_1 + ct) + d = 0 \)
- Substitute \( t \) into \( L \) to get the projection point \( A' (x_2,y_2,z_2) \)

\[
T: ax + by + cz + d = 0
\]

Use Symbolic Solutions

- Solution equations
  - \( t = -\frac{(d + a \cdot x_1 + b \cdot y_1 + c \cdot z_1)}{a^2 + b^2 + c^2} \)
  - \( x_2 = x_1 - a \cdot \frac{(d + a \cdot x_1 + b \cdot y_1 + c \cdot z_1)}{a^2 + b^2 + c^2} \)
  - \( y_2 = y_1 - b \cdot \frac{(d + a \cdot x_1 + b \cdot y_1 + c \cdot z_1)}{a^2 + b^2 + c^2} \)
  - \( z_2 = z_1 - c \cdot \frac{(d + a \cdot x_1 + b \cdot y_1 + c \cdot z_1)}{a^2 + b^2 + c^2} \)
- Implemented practically by numerical calculation
  - Variables \( a,b,c,d,x_1,y_1,z_1 \) should be numbers

Calculation Steps

- Line 733 ~ 744 in material_L12\MotionAna_UI.m
- **Step 1:** calculate the normal vector \([a,b,c]\) of plane \( T \)
  - Cross product of vector \((1 \rightarrow 3)\) and vector \((1 \rightarrow 4)\)
- **Step 2:** calculate the constant \( d \) of plane \( F \) equation
- **Step 3:** calculate \( t \) based on
  - \(-\frac{(d + a \cdot x_1 + b \cdot y_1 + c \cdot z_1)}{a^2 + b^2 + c^2}\)
- **Step 4:** calculate the projection point
  - \( x_2 = x_1 + at \)
  - \( y_2 = y_1 + bt \)
  - \( z_2 = z_1 + ct \)