

MATLAB 動作分析使用者介面 架構與符號運算

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請先下載本週上課資料

- <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

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本週內容

- 動作分析GUI架構
- 符號運算(Symbolic Calculation)



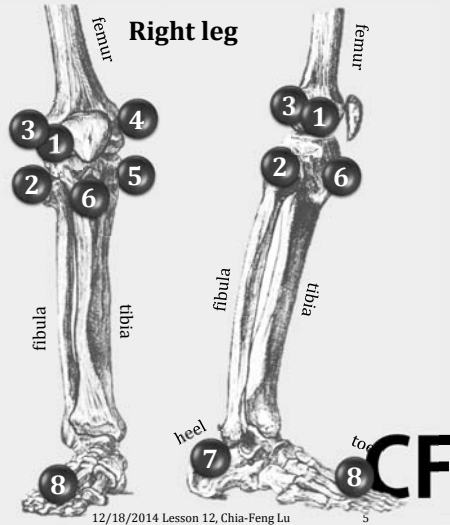
動作分析GUI架構

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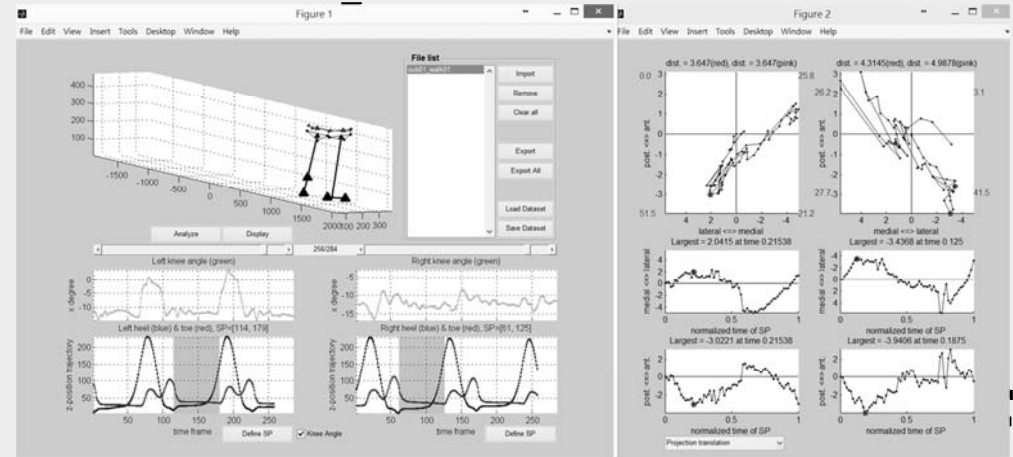
Motion Capture

- Record 3D coordinates of VICON markers during walking.

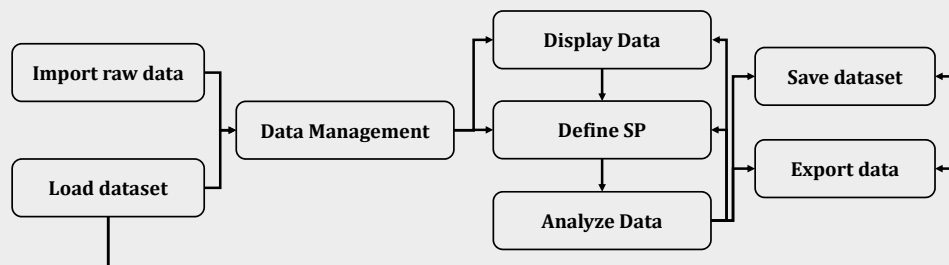
	A	B	C	D	E	F	G
1	LHEE			LTOE			LKNE
2	X	Y	Z	X	Y	Z	X
3	mm	mm	mm	mm	mm	mm	mm
4	-1302.26	307.536	12.3714	-1119.62	337.254	68.9596	-1294.77
5	-1301.05	307.203	12.0885	-1116.68	335.3	61.5159	-1284.19
6	-1301.23	307.717	13.0365	-1113.79	333.352	51.0494	-1273.63
7	-1299.83	308.384	14.4994	-1109.92	332.139	41.7682	-1264.29
8	-1297.92	309.451	16.0093	-1105.4	328.969	41.0194	-1253.56
9	-1296.22	309.963	16.4667	-1102.85	324.964	41.4886	-1243.55
10	-1295.63	310.073	16.7895	-1102.34	325.143	38.4809	-1234.22
11	-1295.23	310.269	17.2871	-1101.25	328.34	34.4016	-1225.65
12	-1294.74	310.584	17.6068	-1099.79	328.815	32.8019	-1217.95
13	-1294.54	310.872	17.7651	-1098.96	327.292	32.9457	-1211.36
14	-1294.56	311.232	17.7646	-1098.72	327.367	32.11	-1205.89
15	-1294.63	311.509	17.6302	-1098.77	328.069	30.5484	-1201.45
16	-1294.77	311.814	17.4298	-1098.8	327.865	30.7754	-1197.4



MotionAna_UI.m



Framework of MotionAna_UI



Locate a Specific Function

- By searching the proper 'string' or 'style'
 - Ctrl + F for quick search

Please locate the codes of

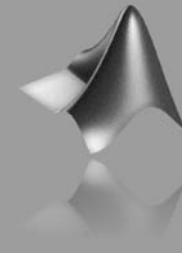
Please locate the codes of

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An Exercise

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

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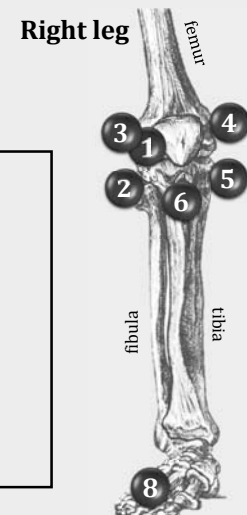
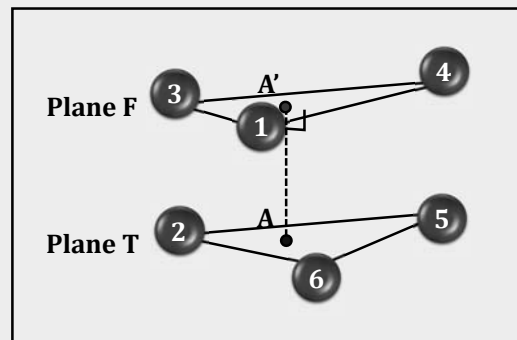


符號運算

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Projection Point

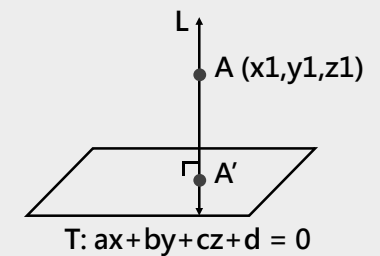
- Project point A on plane T to the plane F...



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

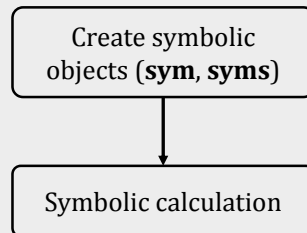
- The line L pass through point A and is perpendicular to plane T:
 - $X = x_1 + at;$
 - $Y = y_1 + bt;$
 - $Z = z_1 + ct;$
- Replace x, y, and z of plane T by the (X,Y,Z) and solve t
 - $a(x_1 + at) + b(y_1 + bt) + c(z_1 + ct) + d = 0$
- Substitute t into L to get the projection point A' (x_2, y_2,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



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MATLAB Symbolic Calculation

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



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Declare symbolic objects

- Remember to declare the symbolic objects before use

- `syms a b c x`
- `f = sym('a*x^2+b*x+c')`

$$ax^2+bx+c$$

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Symbolic Calculation: examples

- **Equation Solving**
 - `f=sym('a*x^2+b*x+c')`
 - `solve(f)`
- **Formula manipulation**
 - `f=sym('a^3+3*a^2*b+3*a*b^2+b^3')`
 - `factor(f)`
- **Calculus**
 - `f=sym('sin(x^2)')`
 - `diff(f)`

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MATLAB Symbolic Calculation

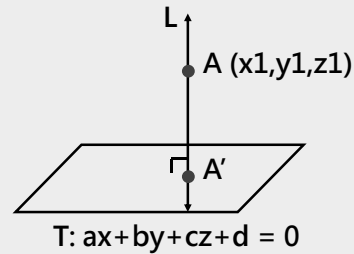
- **Equation Solving**
 - `solve`, `linsolve`, `equationToMatrix`, ...
- **Formula manipulation and simplification**
 - `simplify`, `coeffs`, `expand`, `factor`, `subs`, ...
- **Calculus**
 - `diff`, `int`, `divergence`, `jacobian`, `laplacian`, ...
- **Linear algebra**
 - `det`, `inv`, `gradient`, `svd`, `eig`, `rank`, ...
- **Polynomials**
 - `minpoly`, `coeffs`
- **Mathematical functions**

help symbolic math toolbox

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

- The line L pass through point A and is perpendicular to plane T:
 - $X = x1 + at;$
 - $Y = y1 + bt;$
 - $Z = z1 + ct;$
- Replace x, y, and z of plane T by the (X,Y,Z) and solve t
 - $a(x1 + at) + b(y1 + bt) + c(z1 + ct) + d = 0$
- Substitute t into L to get the projection point A' (x2,y2,z2)



請開啟並執行material_L12\demo_SymbolicCal.m

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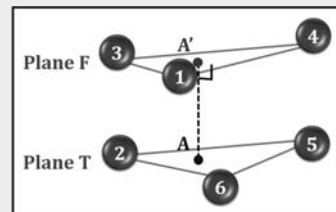
Use Symbolic Solutions

- Solution equations
 - $t = -(d + a*x1 + b*y1 + c*z1)/(a^2 + b^2 + c^2)$
 - $x2 = x1 - (a*(d + a*x1 + b*y1 + c*z1))/(a^2 + b^2 + c^2)$
 - $y2 = y1 - (b*(d + a*x1 + b*y1 + c*z1))/(a^2 + b^2 + c^2)$
 - $z2 = z1 - (c*(d + a*x1 + b*y1 + c*z1))/(a^2 + b^2 + c^2)$
- Implemented practically by numerical calculation
 - Variables a,b,c,d,x1,y1,z1 should be numbers

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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→3) and vector(1→4)
- Step 2:** calculate the constant d of plane F equation
- Step 3:** calculate t based on
 - $-(d + a*x1 + b*y1 + c*z1)/(a^2 + b^2 + c^2)$
- Step 4:** calculate the projection point
 - $x2 = x1 + a*t$
 - $y2 = y1 + b*t$
 - $z2 = z1 + c*t$



THE END

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