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Administration

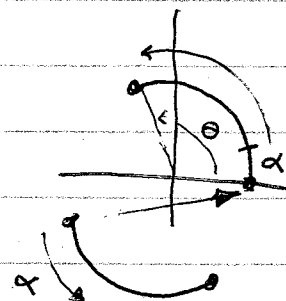
- P1 feedback - coming soon
- P2 directions - coming soon
- P3 grouping email
topics email

Questions : Quaternions : Blending

2D version

angular velocity / half way

- ① rotate picture so start at origin
rotate back when done



- ② distance along curve

- ③ shortcut - small & approx

What is the right way to interpolate?

- dist along circle
- angle
- velocity

Quaternion : $\cos |v|, \frac{v}{\|v\|} \sin \|v\|$ ← rotation vector

UNIT!

beware the
1/2 - from LS02

↓
antipode
issue

$$\cos \frac{\theta}{2}, \hat{v} \sin \frac{\theta}{2}$$

↑
axis

$$\log Q \rightarrow v$$

$$\exp v \rightarrow Q$$

fancy names, easy to do from
definition

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Interpolating Quaternions

SLERP - great circle route - 3D picture (rather than 4D)
interpolate angle in plane (2D)
 $\Rightarrow$ look up slerp equations

What's wrong w/ slerp

slow

doesn't extend past 2 points (Barycentric for 3)
order matters

NLERP - hack!

how bad?

- ① commutes / order independent
- ② robust except for large angles (very)
- ③ symmetric
- ④ doesn't care about what points are
 $\Rightarrow$ not constant velocity

probably good enough in practice

can't prove anything (except upper bound on error)

Log map - problem need "zero point"
(velocity from where)

$$\text{Slerp} = q_1 (q_1^{-1} q_2)^t = v_1 + (v_2 - v_1)t$$

use q_1 as zero point

problem: different zero points give different directions

solution: pick center as zero point

(but how? we need LERP to find it!)

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Parameterization of motion

What?

How: IK + displacement maps for reach

why not? specific to reach (punch, high, ...)
style....
no lead in

Blending - per pose

$$\sum \alpha_i M_i + \dots$$

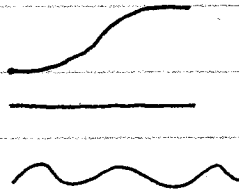
↑ not really sum - $\otimes$ blend operator

Useful for:

transitions

interpolation

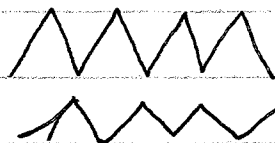
continuous control



But - only works when poses are close (poses)
only works when motions are similar

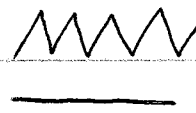
idea - make motions more similar by alignment

Timing



high steps

low steps



medium steps

floating

Coordinate laws

← →
walks in different
directions



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How to align (Time)

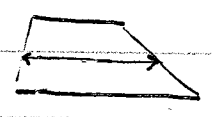
① manual - key time $t_1 = t_1'$
 $t_2 = t_2'$

$f(t') = t$
 $\uparrow$ time warp

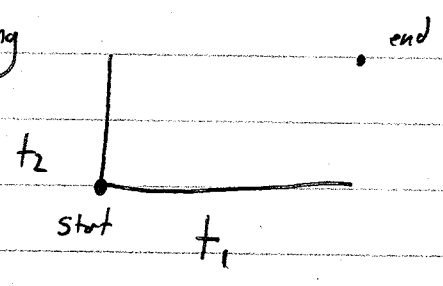
problem re-times to motion 1
 (so it 100% motion 2, you don't really get it)

$$\alpha f + (1-\alpha) f(t)$$

$$(1-\alpha)t + \alpha f^{-1}(t)$$



② dynamic time warping
 distance grid

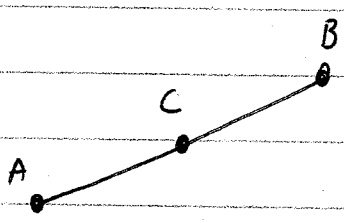


"cost" of path is
 sum of costs

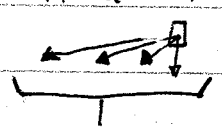
find lowest cost path

Dynamic Programming

suppose AB is optimal
 then AC and CB are optimal



idea find paths from A to everything in ROW
 find path from each in ROW to B - pick best
 advance 1 row at a time



or no verticals to add
 slope limit

limit how far over to look to limit slope