

# Recognition of Laban Effort Qualities from Hand Motion

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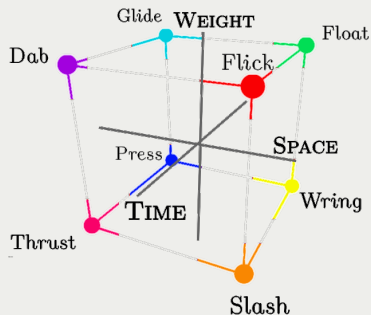
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# Motivation

- Make systems react to user intent (interactive performances).
- Recognize both gestures and motion qualities and transfer them (3D animations)
- Characterize and better understand motion

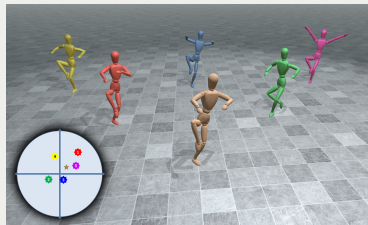
# Motion Quality Representation: Laban Efforts



- 3 axes (Factor) Space, Time and Weight
- Two extremes (Elements) per axis
- Usually combined together: motion Verbs

# Related Work

- Full Body LMA Features Recognition <sup>1</sup>
  - Recognition from mocap data
  - Link between LMA and low level features
  - 3D character animation stylization
  
- Hand Laban Effort Recognition: <sup>2</sup>
  - Wrist motion tracking
  - Muscular activity study
  - Factor and Verb classification study
  - Verbs difficult to classify



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<sup>1</sup>(Aristidou et al. 2017)

<sup>2</sup>(Fdili Alaoui et al. 2017)

# Our method



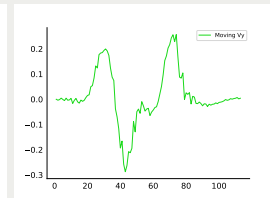
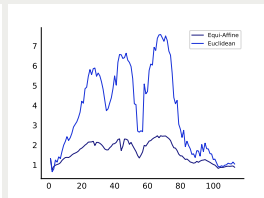
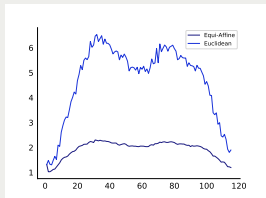
- Recognize Laban Effort qualities from hand motion (6D signal)
- Train and evaluate classifiers for Factor and Verb classification
- Classify with two HMMs types: Verb HMMs and Element HMMs

# Dataset



- 104 Verb training and testing curves:
  - 88 pattern curves: 8 Verb curves per pattern
  - 16 free style Verb curves
- Performed by 2 Laban experts & one person familiar with Laban
- Split dataset between training and testing set (56 and 48 curves)
- Data augmentation for training: 840 curves (105 per Verb)

# Geometric Features



- 3 geometries: Euclidean, Moving frame and Equi-affine:
  - Space: Torsion/Curvature
  - Time: Speed/Acceleration/Jerk in Euclidean and Moving Frame
  - Weight: Equi-Affine Speed
- Constant Equi-Affine Speed = Uniform motion <sup>3</sup>
- $V_a = \det(v_e, a_e)^{1/3}$  in 2D,  $V_a = \det(v_e, a_e, j_e)^{1/6}$  in 3D <sup>4</sup>

<sup>3</sup>(Pollick and Sapiro 1997)

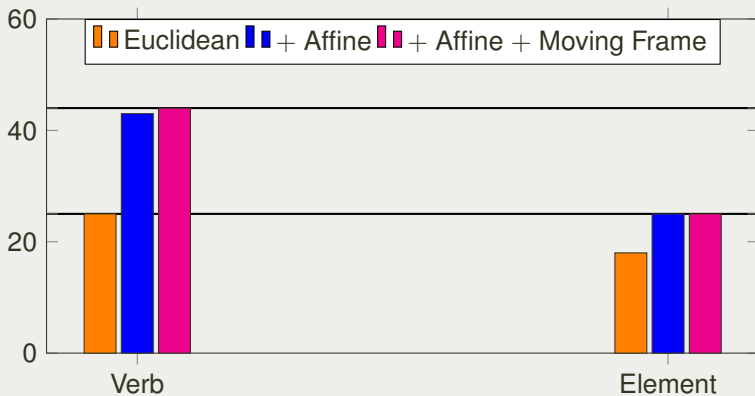
<sup>4</sup>(Pollick et al. 2009)

# Classifiers

- Based on two HMM types:
  - Verb HMMs (one per verb, 8 HMMs)
  - Element HMMs (one per element, 6 HMMs)
- Left-to-right HMMs with 6 states
- Two classification tasks: Factor and Verb classification
- Classification decision: Maximum log likelihood in all cases

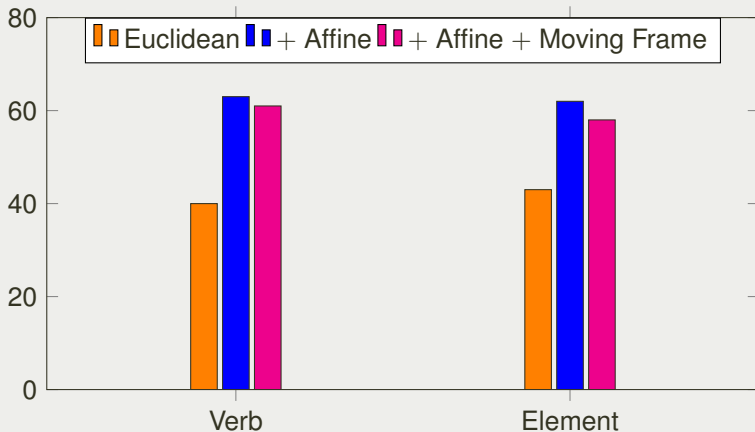


# Verb Classification



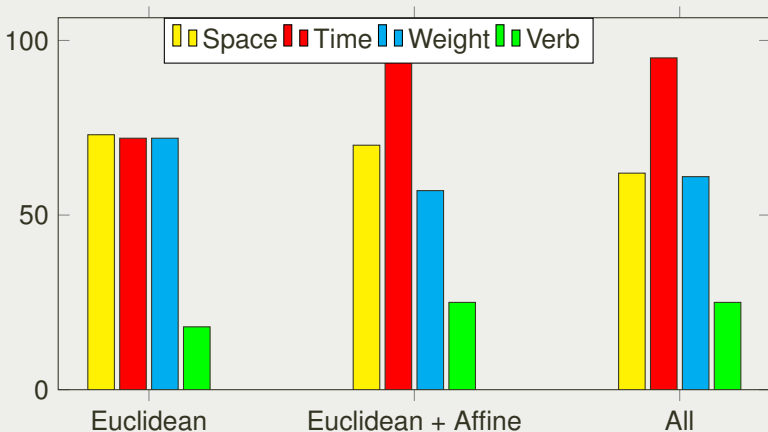
- 44% (Verb HMMs) vs 25% (Element HMMs)
- Equi-affine features greatly improve results
- Moving frame features do not seem to be relevant

# Classification results omitting Space dimension



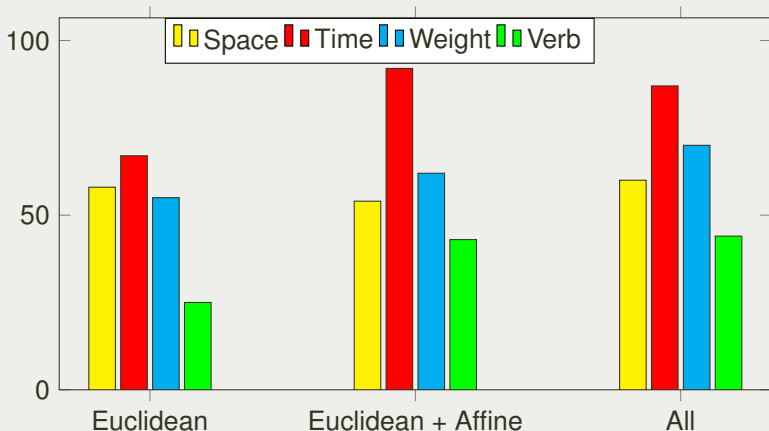
- Results almost identical: Space not recognized when Time and Weight are with Element HMMs

# Factor Classification with Element HMMs



- Factor recognition  $\geq 65\%$  for each Factor
- Time well recognized  $\geq 85\%$
- Element HMMs miss out correlations between Elements

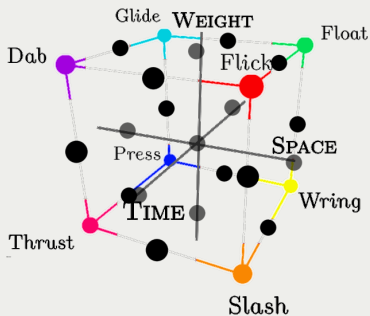
## Factor Classification with Verb HMMs



- Verb HMMs slightly less accurate for Factor classification
- Better capture Element correlations

## Conclusion and Future Work

- Classification of Factors from hand motion only is possible
- Verb classification remains difficult
- Verb HMMs more accurate than Elements HMMs
- Create a complete dataset using inputs from 20 LMA experts in the 27 possible combinations of Factors
- Include physiological data and compare with our features



# Questions ?