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Towards constructing a historically-grounded gesture-timbre space of Guqin playing techniques

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Introduction:

Guqin is an ancient (~3000 yo) Chinese zither instrument known for its **timbral variability**. Most of its playing techniques were developed no later than Ming Dynasty (14-16 century). Numerous ancient text dating back to the 900s have provided guidelines for gestures of defined Guqin playing techniques and recommendations on timbre aesthetics.

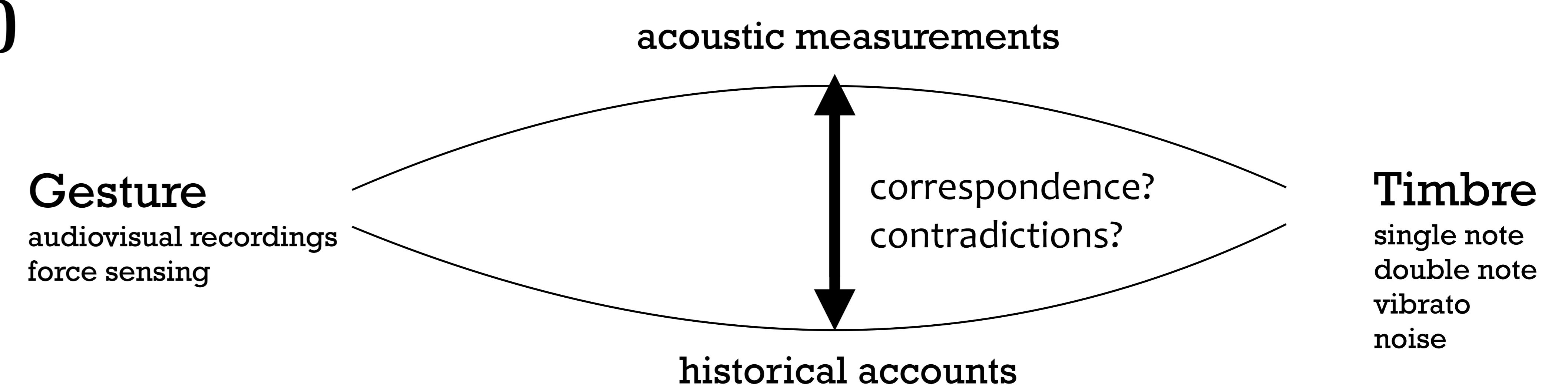
Nevertheless, a large part of Guqin pedagogies is **metaphoric**, mind instead of body-centered, and include **limited justifications** on recommended gestures.

Objective:

This work attempts to **digitize and concretize** the sonic implications in Guqin gesture-timbre writings, and variegate within the vocabulary of playing techniques by designing and recording a **dataset of isolated, short representative Guqin timbres labeled by gestural data**.

The Text: <Tangchenzhuo zhifa> 唐陈拙指法 (est 860~900)

- Chen Zhuo 陈拙 (Late Tang dynasty: mid 9th century)
- Include technical (hand control and tone production) and expressivity (aesthetics of tone) instructions 【诀, 法, 用】, on three fundamental elements of qin playing 【指, 声, 韵】: finger, sound, resonance

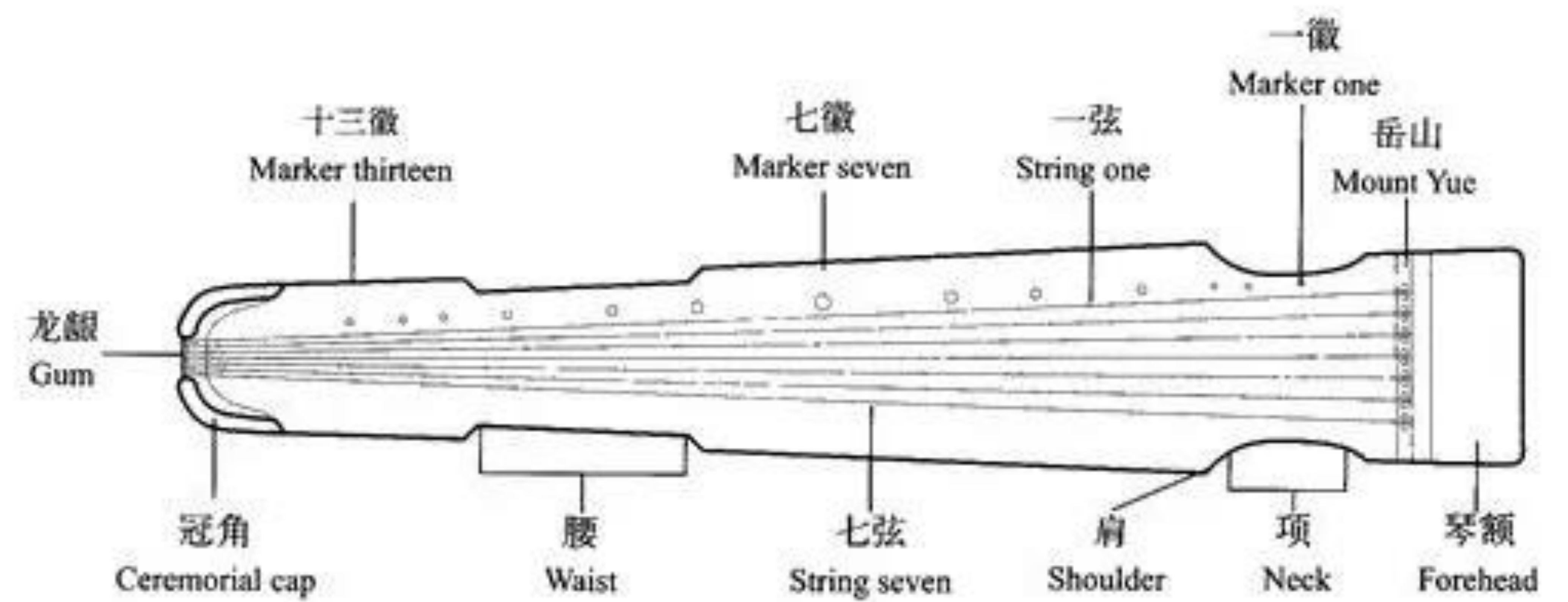


Case Studies:

How do the gestural degrees of freedom identified for each case affect the resulting timbres?

Acoustics-oriented techniques:

- **Single note open string**
 - 指分远近轻重徐急: "For short sounds the finger is positioned on the surface, passing lightly over the string, the attack light and sudden; For long sounds, the finger slowly approaches from far away, goes deep into the string and attacks violently"
 - 声分刚柔: "The outward plucking corresponds to firm sounds - clear and far-reaching; the inward plucking corresponds to soft sounds - harmonious and unctuous"
- **Single note harmonics**
 - 徽正则鸣, 徽差则塞: "Sound rings only if finger strikes at precisely the markings, otherwise it will be dampen and stuffy."
- **Double note**
 - How do the two notes fuse under different modes of attacks?



Context-dependent techniques:

- **Vibrato and portamento**
 - **Resonance:** how do force and timing of lefthand movement affect the modification of resonance
 - **Noise:**
 - noise from nails (right hand attack)
 - noise from flesh (left hand portamento/vibrato)

Feature extraction:

- **Gestural:** fingers, attack positions, direction, inferred force, left/right hand timing coordination
- **Timbral:**
 - **Partials distribution moments:** centroid, skewness, kurtosis
 - **Spectrotemporal modulations:** Joint time-frequency scattering Transform (JTFS)
 - **Noise:** Noise-to-harmonics ratio
 - **Deep embeddings:** openl3

Gesture-Timbre Space:

- **Multidimensionality scaling:** Isomap, TSNE, PCA
- Future: gesture-conditioned timbre synthesis

\ Gestural DoF	Right hand				Left hand							
	position	finger	direction	excitation mode	position	point of contact	amplitude	frequency	force	timing		
single note	1. ~9cm from Mountain Yue 2. marker 1 3. marker 2-3 4. marker 4 5. marker 5-6	1. thumb 2. index 3. middle 4. ring	1. inward 2. outward	1. basic pluck 2. flick 掣 3. slap 提 4. knock 敲								
single note harmonics				selected and adapted pluck techniques							selected markers and their deviates	1. 抑泛 (index) 2. 覆泛 (thumb and index) 3. 牙泛 (thumb)
double note				selected chords (octave, fifth, tritone, second)							1. open 2. pressed 3. harmonics 4. open+harmonics 5. open + pressed 6. pressed + harmonics	
vibrato / portamento				selected start and end positions							1. between flesh and nail 2. finger belly 3. knuckle	1. long 2. short 3. circular

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