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Guzheng Notation Past and Present: A Systematic Comparison of Traditional Character-Based and Modern Notation Systems in the Digital Age

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Abstract: The guzheng, a Chinese plucked zither with more than two millennia of history, developed its notation from early character-based texts through the mature gongche and er-si systems to the modern numbered and staff notations now universally taught. As the core carrier of musical information, notation connects composition, performance, pedagogy and research, and every transformation of notational form has left a deep imprint on the trajectory of guzheng music. Yet scholarship has largely confined itself to historical description of single notation systems or to standardization of technical symbols, lacking a systematic comparison of ancient and modern systems and sustained attention to digital technology and its integration with practice. As an early-stage research output of a monograph study of guzheng notation, this paper builds an integrated framework moving from historical evolution to structural comparison, from semiotic and cross-cultural interpretation to digital-era exploration, and finally to integration in performance and teaching. Along four core dimensions - pitch, rhythm, technique and tonal nuance (yinqiang) - it shows that ancient and modern systems rest on different representational logics, and argues that guzheng notation theory should combine historical depth with contemporary vitality and academic rigor with practical applicability. Implications extend to curriculum design, archival methodology, digital encoding standards and the place of Chinese instrumental music in global music theory.

Keywords: guzheng; notation systems; character notation; gongchepu; er-si notation; jianpu; staff notation; digital music technology

1. Introduction

1.1. Background and Research Gap

Over more than two thousand years, guzheng art has accumulated profound cultural meaning and a distinctive artistic system, and notation has been the central vehicle through which that music is transmitted and inherited - the bond connecting composition, performance, teaching and research. Its development is well known in outline: from the brief descriptions of early character-based scores (wenzi pu), through the mature application of gongchepu and er-si notation, to the comprehensive popularization of numbered notation (jianpu) and staff notation, and each change of notational form has deeply influenced the trajectory of guzheng music. Current research nevertheless shows two deficiencies. Studies tend to concentrate on the historical combing of one notation system or on the normative discussion of technical symbols, and they rarely compare the ancient and the modern systems as wholes; meanwhile the genuinely transformative changes brought by digital technology, and the integration of notation with contemporary practice, have not received due attention. Against this background, the present paper - drawing on the systematic framework of a monograph-length study - undertakes such a comparison and explores innovation pathways in the contemporary technological context, aiming to contribute to a guzheng notation theory with both historical depth and contemporary vitality.

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1.2. Methodological Framework

The study is multi-disciplinary, integrating musicology, semiotics, cognitive science and digital technology under three principles: the unity of history and logic, which traces development while exposing its internal logic; the unity of theory and practice, which anchors every theoretical claim in the concrete needs of zheng composition, performance and teaching; and the unity of inheritance and innovation, which takes the cultural value of traditional notation seriously while exploring digital pathways without nostalgia. The study thus seeks to balance academic and practical value, and it compares the two families not by judging one with the yardstick of the other but by analyzing each system's representational logic on its own terms before confronting them.

1.3. Scope and Structure

The paper mirrors the logical chain of the underlying monograph: historical tracing, theoretical comparison, cross-cultural and semiotic examination, contemporary digital exploration, and practical integration. "Traditional character-based notation" refers collectively to the wenzi pu, gongchepu and er-si families; "modern notation" refers to jianpu and staff notation, introduced from the late nineteenth century onward. Section 2 traces historical evolution; Section 3 compares systems along pitch, rhythm, technique and tonal nuance; Section 4 adds semiotic and cross-cultural perspectives; Section 5 treats symbol libraries, data-based storage, artificial intelligence and multimedia scores; Section 6 discusses integration in performance and teaching and outlines a reconstructed theory; Section 7 concludes.

2. Historical Evolution: From Character-Based Systems to Modern Notation

2.1. Traditional Notation and Its Theoretical and Aesthetic Core

The earliest guzheng scores belong to character-based notation, whose brief written characters described which strings were to be played and how, serving as mnemonic scaffolds for an orally transmitted practice rather than as autonomous sonic documents. As the tradition matured, two further character-based systems became established: gongchepu, which recorded pitch with Chinese syllables and supported rhythm through the ban-yan (beat-and-eye) framework, and er-si notation, used chiefly in the Chaozhou tradition, whose numerals such as er, si, san and liu took on "light", "heavy" and "active" readings encoding regional modal inflections [1, 2]. These systems embodied a theoretical core in which pitch was relational and modal, rhythm was carried by gesture and oral convention, and notation existed to refresh the memory of a performer who already possessed the idiom [3]. Their aesthetic orientation was correspondingly performer-centered: the score was a scaffold for interpretation rather than a prescription of sound, sustaining regional schools and their distinct expressive dialects for centuries. Grasping this core is the precondition for any fair comparison with modern systems.

2.2. The Introduction and Establishment of Modern Notation

Modern notation entered Chinese musical life through educational modernization. Jianpu, imported through school-song practice at the turn of the twentieth century, spread quickly for its simplicity; staff notation was later adopted by conservatories and official publishing houses to serve standardization, cross-instrumental coordination and systematic documentation [1]. For the guzheng this arrival did not at first displace traditional scores: early modern editions acted as a translational interface, mapping traditional technique signs and modal practice onto the new visual framework, with the choice between jianpu and staff notation often a matter of editorial convenience. The decisive change came with institutional codification: once staff notation was embedded in curricula, examinations and repertoire lists, fluency in it became a marker of professional legitimacy, while traditional scores receded into archival preservation and regional transmission [2]. The outcome was not replacement but a layered notational landscape in which the two families coexist under different institutional conditions - a coexistence whose structural consequences the next section examines.

2.3. *Why Systematic Comparison Is Needed*

Each stage of this history has been studied in isolation, and the literature is rich in single-system histories and proposals for standardizing technique symbols. What is lacking is comparison at the level of whole systems: not "which score is more accurate" but "what musical knowledge each system can carry, and what it necessarily leaves out". Because every transformation of notation has deeply affected guzheng music, the historical record itself argues for such a comparison. Modern repertoire circulates mainly in modern notation, while the traditional repertoire survives in character-based scores and their attached oral practice, and performers and teachers must move between these worlds daily; a systematic comparison therefore answers an academic gap and a practical predicament alike, and prepares the integration pathways of Section 6.

3. A Systematic Comparison of Ancient and Modern Notation Systems

3.1. *Pitch: Relational Modality Versus Fixed-Pitch Abstraction*

The most fundamental difference concerns pitch. Character-based systems record pitch relationally: gongchepu names pitches within a movable modal frame, and er-si notation encodes scale degrees whose intonation is flexible and context-dependent, as when san and liu take "light", "heavy" or "active" readings according to mode and melodic gesture [2]. The performer supplies actual sounding pitch through tuning, register and idiom. Staff notation, by contrast, fixes pitch as an absolute position on a grid presupposing equal temperament and a stable reference pitch. For an instrument as intonationally flexible as the guzheng - pressed strings bend pitch continuously, movable bridges make alternate tunings routine - this fixed-pitch abstraction enables precise communication with other instruments while obscuring the modal-relational thinking that organizes traditional repertoire [4]. The contrast is ontological, not a matter of accuracy: relational pitch treats intonation as a living contextual property, fixed-pitch notation as a parameter to be specified and controlled.

3.2. *Rhythm: Fluid Gestural Time Versus Metric Quantization*

Traditional notation is economical in rhythmic specification. Early scores record time only implicitly, and even the mature systems rely on the ban-yan framework and the performer's internalized idiom; rhythmic nuance is carried by oral transmission, by the natural duration of plucked and damped sounds, and by the freedom of traditional phrasing [3]. This fluidity preserves interpretive elasticity and lets regional schools realize the same score with different temporal characters. Modern notation quantizes time into metrically defined units, making rhythm explicit, teachable and reproducible, but the gain has a price: the metric grid segments time into mutually exclusive cells and represents onsets and offsets as punctual events, erasing the zheng's time-extended articulations - the growth of a vibrato, the decay and release of resonance, the elastic transition between plucked and brushed sounds [5]. Character-based notation trusts the performer's time; modern notation instructs it. The former preserves process, the latter product.

3.3. *Technique and Gesture: Action Syntax Versus Sonic Prescription*

Traditional guzheng scores are, at bottom, records of action. Their signs tell the hand what to do - which finger plucks, which string sounds, whether the left hand presses, vibrates or dampens - and the sounding result follows from the action executed in context [6]. Technique is thus not an accessory layer added to pitch but the very substance of the notation: the score and the player's idiomatic body form one system. Modern notation reverses the relation: it prescribes sonic outcomes - pitch, duration, dynamics - and is silent about physical production, so that whether a tone is plucked by thumb or middle finger, whether it is a natural or artificial harmonic, and whether it carries vibrato must all be added through supplementary markings whose conventions are far from standardized. For the traditionally trained performer this silence is liberating; for the student who knows only modern notation it is a constant source of uncertainty. Character-

based notation is action syntax; modern notation is sonic prescription; and transliteration between them always loses either the gesture or the specification that generated it.

3.4. Tonal Nuance (Yinqiang): What Notation Cannot Say

The deepest layer of guzheng expression - what Chinese discourse calls yinqiang, the living tonal nuance of a phrase - lies where the two families are least equipped to meet. Traditional practice encodes it in microtonal inflections of pressed strings, in the speed and depth of vibrato, in the weight and point of attack, and in the timing of damping and release; character-based scores gesture toward these dimensions through the density and placement of their signs and rely on the performer's somatic memory to complete them [2]. Modern notation, with its discrete symbols and quantitative grid, has no native vocabulary for continuous pitch bends, the trajectory of a slide or the spectral evolution of a plucked tone, although acoustic studies confirm that such parameters are objectively measurable and perceptually decisive [5]. Attempts to capture yinqiang in modern notation multiply ad hoc signs and verbal annotations, burdening the score without resolving the issue: notation that abstracts sound into discrete quantifiable events cannot by itself carry a dimension of meaning that is continuous, timbral and gestural [7]. This is not a defect that better engraving could repair; it reflects the different ontological commitments of the two families.

4. Semiotic and Cross-Cultural Perspectives

4.1. Notation as a System of Signs

A semiotic reading sharpens the comparison. The characters and numerals of traditional scores are predominantly indexical and actional signs: they point to strings, fingers and movements within a shared practice, and their meaning is inseparable from context [3]. The symbols of modern notation are predominantly symbolic in the strict sense: they denote acoustic parameters by arbitrary but fixed convention and are readable apart from any instrument or performer. Traditional scores thus appear opaque to the uninitiated because their signs were never meant to carry meaning in isolation, and the two systems cannot be mapped sign by sign, since their units operate at different levels - embodied action on one side, abstracted sound on the other. Read in this light, the history of guzheng notation is a gradual migration from indexical, context-bound signs toward symbolic, context-free ones, a migration with consequences for who controls the meaning of a score and for how the aesthetic ideals of zheng music - its imagery, resonance and conception of artistic mood - are transmitted [8].

4.2. A Cross-Cultural Comparison

The guzheng is not alone in facing this migration. Western music made the same journey from tablatures and neumes - notations of how to produce sounds - to the pitch-time grid of the modern staff and still feels the tension between notation as instruction and notation as description; the parallel but independent trajectory of the zheng and its sister instrument the guqin confirms that the problem is general [2]. Cross-cultural comparison also clarifies what is at stake institutionally: where staff notation became the lingua franca of Chinese conservatories, it carried an implicit theory of music - discrete pitches, metrical time, composerly authorship - that does not always fit the guzheng's processual, performer-centered practice. Recognizing this is not an argument against modern notation, which is indispensable for ensemble music, large-scale composition and international exchange; it is an argument for treating notation choice as a cultural and epistemological decision rather than a merely technical one.

4.3. Transcription as Re-Embodiment

The semiotic and cross-cultural analysis yields a single practical conclusion: transliteration between the two families is not decoding but re-embodiment. When a traditional score is rendered in staff notation, the editor decides for every phrase what to keep and what to sacrifice; when a modern work is notated for traditional performance, the performer must translate written pitch and rhythm back into the actions and nuances

the notation never specified. Neither direction is lossless, and the losses fall systematically on the dimension the target system cannot represent [8]. Glossaries, alignment tables and hybrid scores, however useful, cannot dissolve this incommensurability: they add information but cannot change what each system treats as primary. The honest formulation is that the two systems are complementary knowledge architectures, each carrying part of the musical intelligence of the guzheng, and that the task of theory is to understand and manage the difference, not to eliminate it.

5. Digital-Era Exploration and Innovation Pathways

5.1. Symbol Libraries and Data-Based Storage

The digital environment offers the first genuinely new notational medium since the staff, and it changes the terms of comparison. Digital technology permits symbol libraries that represent the full inventory of traditional signs - characters, numerals, fingering and technique marks - together with gestural and contextual metadata the printed page cannot carry, and data-based storage can preserve traditional scores not as images but as structured information in which every sign, position and regional variant is retrievable, making the corpus searchable and analyzable for the first time [9]. The task is urgent, for much traditional notation survives only in fragile manuscripts and the memories of aging performers. But digitization is not neutral: if traditional signs are encoded in data models designed for staff notation, the gesture and elasticity that define them are lost at the moment of capture. Symbol libraries and storage standards must therefore be designed around the representational logic of the traditional systems from the outset.

5.2. Artificial Intelligence and Computational Analysis

Artificial intelligence offers promise and risk. Machine learning can assist in recognizing and transcribing historical scores, analyzing performance style from audio, calibrating intonation and generating teaching materials, and preliminary systems for symbolic music generation and intonation analysis point in these directions [10, 11]. Such tools could give students of traditional repertoire computational analyses of regional style and help researchers trace notation and performance practice across large corpora. The risk is that models inherit the assumptions of their training data: most music-processing frameworks presuppose staff-notation concepts - discrete pitch classes, metrically quantized time - and an AI trained on them will misrepresent the continuous, gestural dimensions central to guzheng music unless the models are redesigned around multimodal representations joining audio, gesture and notation [12]. Artificial intelligence will not solve the notational problem by itself; it will reproduce it in software unless the underlying representation is deliberately chosen.

5.3. Multimedia Scores and Integrated Platforms

The most concrete digital innovation is the multimedia score, which integrates the symbolic layer with synchronized audio, video, animation and text. For the guzheng this is potentially transformative, because the dimensions printed notation cannot carry - the trajectory of a slide, the depth of a vibrato, the resonance of a plucked string - can be shown rather than described, and experiments fusing virtual and real environments for zither composition and performance already indicate how the symbolic and the audiovisual can be joined [12]. Interactive platforms can link scores to recordings of different regional schools, and immersive virtual environments for guzheng teaching point the same way [13]. The remaining problems are standards and sustainability: multimedia scores are prototypes rather than an interoperable format, and their creation demands skills most notation editors lack. Yet the digital environment provides the technical conditions for a synthesis the printed page never could - one in which the historical depth of traditional notation and the precision of modern notation are no longer mutually exclusive.

6. Integration in Performance and Pedagogy: Toward a Reconstructed Theoretical System

6.1. Fusion Pathways in Performance and Teaching

The practical question - how to live with two notational families - admits concrete answers. In performance, the goal is not to abolish one system in favor of the other but to cultivate fluency in both, moving between the gesture-based world of traditional scores and the precision-based world of modern notation without treating either as a deficient version of the other. In pedagogy, that dual fluency must be built deliberately, and research on the formation of guzheng teachers confirms that the change is a matter of curricular design and choice-making rather than individual preference [14]. The toolbox includes comparative score study, in which students analyze how the same piece is transmitted in the two families and expose the interpretive affordances of each; gesture-led exercises, in which students translate their own playing into traditional signs and recover the kinesthetic logic of notation; and the reconstruction of scores from archival recordings, which trains the critical listening on which traditional transmission depended. Because such methods change what is assessed, assessment frameworks should reward analytical depth and expressive intentionality rather than fidelity to a single notated surface [15]. Worked examples from documented repertoire - such as the widely studied zheng song "Han River Rhyme" - show how comparative analysis proceeds in practice [16]. Teacher training and cross-institutional exchange are the levers that would spread these methods beyond individual innovators.

6.2. Toward a Systematic Theory of Guzheng Notation

Beyond these measures, the comparison points toward a reconstructed systematic theory that treats the traditional and modern families, together with the emerging digital layer, not as competitors but as components of one historically layered system. Three requirements follow. The first is systematicity: the theory must account for the whole sequence - from character-based texts through gongchepu and er-si notation to jianpu, staff notation and digital media - and for the logic connecting its stages. The second is compatibility: it must describe what each system represents and omits, so that transliteration, hybrid scoring and multimedia design proceed from explicit knowledge rather than improvisation. The third is practicality: its concepts must be testable in the studio and the classroom as well as the archive [15]. A theory meeting these requirements would have the historical depth that comes from taking the tradition seriously and the contemporary vitality that comes from engaging the digital environment without discarding it.

6.3. Implications and Outlook

The implications reach beyond the guzheng. For composition, notation should be a design space in which idiomatic parameters are first-class elements rather than afterthoughts; for musicology, notation deserves study as a carrier of musical epistemology rather than as neutral transcription; for archives, preservation strategies should respect each system's representational logic; and for global music theory, a non-Western instrument's notation can illuminate general questions about notation, cognition and musical meaning. Future research should develop and validate digital symbol libraries and multimedia score prototypes, study dual-notation pedagogy empirically, and extend the comparison to other Chinese instruments on the same historical trajectory.

7. Conclusion

This paper has argued that the ancient and modern notation systems of the guzheng differ not in accuracy but in kind. Character-based notation - the wenzi pu, gongchepu and er-si families - encodes relational pitch, fluid time, embodied technique and tonal nuance within a performer-centered epistemology; modern notation - jianpu and staff notation - encodes fixed pitch, quantified time and sonic prescription within a composer-centered one. Comparison along pitch, rhythm, technique and yinqiang shows each system to be coherent and internally complete, their differences rooted in divergent ontologies of musical meaning rather than technical deficiency. The semiotic and cross-

cultural analysis explains why transliteration is necessarily re-embodiment; examination of the digital environment shows that symbol libraries, data-based storage, artificial intelligence and multimedia scores offer the first genuine opportunity to reconcile inheritance with innovation; and the integration pathways of Section 6 translate this understanding into practice, supporting the reconstruction of a systematic guzheng notation theory. As an early-stage research output of a larger monograph study, this paper presents the skeleton of that framework; its historical detail, notational examples and pedagogical materials are developed in the monograph itself. Understood properly, guzheng notation is not a technical problem awaiting a final solution but a living system that has carried the music of the zheng for more than two millennia and is now, in the digital age, being renewed.

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