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Optimization study of artificial intelligence on dispute resolution models in criminal proceedings

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Abstract: Purpose: To explore how artificial intelligence (AI) can transform criminal litigation dispute resolution in real-world judicial practice, focusing on resolving persistent challenges in cross-regional mediation, including legal application discrepancies and mediation model heterogeneity. Design: We integrate data from the national court electronic case file system and the Supreme People's Court's judicial big data platform to construct a criminal mediation case database covering eastern, central, and western China. Using a domain-adaptive approach to standardize legal elements, we build a dispute prediction model combining deep adversarial networks with temporal attention mechanisms. Multidimensional feature vectors incorporate behavioral trajectories, social relationship networks, and historical caFse similarity analysis. Findings: The model achieves 81.4% accuracy in predicting successful mediations—33.6 percentage points higher than traditional legal analysis. In small-sample scenarios (e.g., border regions), it maintains 79.2% accuracy, demonstrating robust adaptability for resource-constrained courts. Conclusion: This study confirms AI's capacity to unify regional judicial standards and provides an interpretable framework for data-driven dispute resolution in criminal practice.

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Keywords: Artificial intelligence; Criminal proceedings; Dispute resolution.

1. Introduction

Contemporary society witnesses an unprecedented confluence of intricate social dynamics and rapid technological advancement, engendering increasingly complex and diverse disputes that find their way into criminal proceedings[2]. Against this backdrop, the limitations of conventional dispute resolution methodologies become starkly apparent. These traditional models, heavily reliant on manual practitioner experience and often strained by the intricate nuances of legal interpretation, exhibit critical deficiencies that undermine their efficacy[3]. Pronounced issues include persistent inefficiency in handling burgeoning caseloads and a troubling lack of consistency and precision in outcomes, particularly when navigating the labyrinthine complexities of cross-jurisdictional conflicts[4]. The profound challenges encountered in mediating such disputes are significantly exacerbated by stark disparities in how local laws are applied and the heterogeneous, often incompatible models employed by different mediating bodies[5]. These factors collectively contribute to a dismal success rate for mediation efforts, especially in intricate cross-regional cases, where cultural expectations, economic contexts, and judicial practices diverge sharply[6].

Concurrently, the rapid maturation of artificial intelligence presents a momentous, albeit complex, opportunity to fundamentally reshape this landscape[7]. No longer confined to theoretical abstraction, AI technologies–encompassing sophisticated data analytics, adaptive machine learning systems capable of pattern recognition from vast datasets, and natural language processing engines that decipher legal semantics – offer tangible potential[8]. These tools empower legal professionals to analyze case materials with unprecedented speed and depth, identify patterns invisible to the human eye, and access relevant precedents with ease. The promise lies in enhancing the procedural efficiency of dispute resolution while concurrently elevating its ultimate success rate and overall fairness[9]. Within China, the exploration of AI's legal applications has gained significant momentum in recent years. Research endeavors are increasingly venturing into realms such as the automated drafting of complex legal documents, the creation of AI-driven legal advisory interfaces, and predictive analytics attempting to forecast case trajectories and outcomes. Leading academic institutions and specialized research centers have

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[2] LOEBL, Z. & REZABKOVA, T. "Forward-looking approach to online dispute resolution (odr) in light of the current and forthcoming eu digital legislation", International Journal of Online Dispute Resolution, 10(1), 2023.
[3] MAHYUT, S. M. B., IBRAHIM, A. S. B., JASMEE, N. D. B. M., AZAM, N. D. B. N., HANAN, D. N. B. B. N. & AZLI, F. A. B. M. "Navigating industrial disputes: legal perspectives and precedents", Pakistan Journal of Life & Social Sciences, 22(2), 2024.
[4] ZEBERGA, M. S., HAASKJOLD, H. & HUSSEIN, B. "Digital technologies for preventing, mitigating, and resolving contractual disagreements in the aec industry: a systematic literature review", Journal of Construction Engineering and Management, 150(6), 2024, p. 19.
[5] YANG, C., LIN, C., ZHAO, W. & CUI, J. "A novel blockchain-based charitable model combined with insurance", The Geneva Papers on Risk and Insurance - Issues and Practice, 50(1), 2025, p. 185-202.
[6] CZAJA, J. "The application of artificial intelligence-based decision-assisting tools to the mediation process -- an analysis of risk and opportunities", Forum Prawnicze, 84(4), 2024.
[7] ATANASIOUS, M. M. H., BECCHETTI, V., GIUSEPPI, A., PIETRABISSA, A., ARCONZO, V. & GORGA, G., et al. "An insurtech platform to support claim management through the automatic detection and estimation of car damage from pictures", Electronics, 13(22), 2024.
[8] MAGALHES, M. L. P. "Disruptive technologies and the rule of law", Brazilian Journal of Law, Technology and Innovation, 2023.
[9] MEI, Y. & DUAN, Y. "The dikwp (data, information, knowledge, wisdom, purpose) revolution: a new horizon in medical dispute resolution", Applied Sciences-Basel, 14(10), 2024, p. 33.

Launched pioneering projects deploying machine learning algorithms to dissect patterns within historical criminal case data. However, a critical gap persists within this burgeoning domestic research sphere: it predominantly orbits around theoretical frameworks and demonstrations of technical feasibility, leaving a striking absence of robust, empirical evaluation regarding the actual impact and effectiveness of these AI tools in the pressurized, real-world crucible of legal practice[10]. The paucity of evidence concerning how AI truly functions within live judicial environments hinders its responsible adoption. Recent comparative studies further highlight jurisdictional divergences in AI governance. As Mrčela & Vuletić (2023) demonstrate through neurotechnology case analysis, European systems prioritize procedural safeguards against algorithmic self-incrimination (e.g., GDPR's right to explanation), whereas U.S. frameworks emphasize utilitarian efficiency gains. Our triple-validation mechanism synthesizes these approaches by embedding due process protections within operational workflows[11].

By contrast, the international arena reveals a more mature engagement with legal AI. Pioneering legal technology entities across numerous jurisdictions have developed and deployed a diverse suite of AI-powered tools actively assisting lawyers in case strategy formulation, discovery management, and judges in identifying relevant jurisprudence and potential biases in arguments[12]. Studies, particularly in common law jurisdictions, have leveraged machine learning to analyze enormous repositories of historical judgments, yielding predictive models aimed at informing outcomes with a veneer of algorithmic objectivity, thereby purporting to inject enhanced scientific rigor into judicial deliberations. Beyond functionality, international discourse also demonstrates significant attention to the profound ethical and regulatory quandaries unleashed by AI in the legal domain. Concerns around algorithmic opacity, potential bias embedded within training data, threats to procedural fairness, and serious privacy implications are actively debated, with attempts underway to formulate ethical frameworks and legislative responses, such as the European Union’s AI Act[13]. In contrast to the EU's AI Act which mandates ex-ante conformity assessments for high-risk systems, this study proposes an embedded “Triple Validation” framework (Section 3) that integrates real-time ethical barriers during AI operation. Whereas the EU emphasizes centralized regulatory compliance, our approach prioritizes dynamic judicial oversight – requiring provincial courts to substantively review AI-generated virtual cases – thus addressing algorithmic overreach through institutional checks rather than technical standards alone. This distinction reflects China's context-specific balancing of technological innovation and judicial sovereignty.

Despite these parallel developments globally, the integration of AI into criminal dispute resolution remains fraught with significant conceptual and practical shortcomings that demand urgent scholarly attention. First, the crucial dimension of cross-jurisdictional and multi-faceted dispute heterogeneity is vastly underrepresented[14]. Most models are conceived and validated within relatively

[10] HAN, G. "Predicting critical path of labor dispute resolution in legal domain by machine learning models based on shapley additive explanations and soft voting strategy", Mathematics, 12, 2024.
[11] M. Mrčela and I. Vuletić, "Rethinking the Privilege Against Self-Incrimination in Terms of Emerging Neuro-Technology: Comparing the European and United States Perspective", Croatian Yearbook of European Law and Policy, 19 (2023), 207–223.
[12] Vlcu, Elise Nicoleta . "Synoptic approach regarding the implications generated by the use of 'ai systems' in business-to-consumer contracts." Cadernos de Dereito Actual 24(2024).
[13] AL-ZUBIDI, M. A. "Contract administration and its future in saudi arabia", Global Journal of Management and Business Research, 2023.
[14] FENG, Z., LIU, Y., QIN, B., ZHAI, M. & SUSILLO, W. "Secure and fair data trading based on blockchain with enhanced access control", IEEE Internet of Things Journal, 12(6), 2025, p. 7277-7292.

homogenous contexts, failing to account adequately for the stark differences in legal application, social norms, and mediation practices across regions or within diverse case typologies[15]. The insufficient adaptability arising from this oversight renders many AI systems brittle when confronted with the true heterogeneity of disputes in practice. For instance, an algorithm optimized for standard economic crimes in an Eastern metropolis might perform disastrously when applied to a complex, culturally imbued restorative justice case prevalent in Western rural regions, where community dynamics and local customs fundamentally shape conflict resolution expectations.

Second, the persistent issue of fragmented legal application poses a formidable technical and policy challenge. Existing approaches often struggle to model and reconcile systemic differences in judicial interpretation across regions, leading to predictive models whose performance becomes dangerously erratic and unreliable when deployed beyond the specific judicial environment for which they were initially designed[16]. This inconsistency undermines the very goal of promoting fairness and predictability through AI.

Third, and perhaps most critically, deep-seated concerns regarding ethics, procedural justice, transparency, and legal accountability remain inadequately addressed. The opaque "black-box" nature of many advanced deep learning models creates a direct conflict with foundational legal principles mandating transparency in judicial reasoning, such as Article 6 of China's Criminal Procedure Law[17]. The inability to elucidate how an AI arrived at a mediation recommendation or case prediction fundamentally impairs parties' rights to understand decisions affecting them and erodes judicial accountability[18]. The EU's explicit prohibition of opaque AI in law enforcement underscores the global recognition of this challenge. Furthermore, establishing clear lines of legal responsibility when AI recommendations influence, or cause, unjust outcomes constitutes uncharted and complex legal territory[19]. How can we safeguard the inherent values of due process and fair trial rights when critical interventions are suggested by algorithms whose inner workings defy explanation? How can the unintended biases potentially ingrained within data or algorithms be detected and mitigated before they cause systematic discrimination?

This study therefore emerges with a vital mission: to bridge these critical gaps, moving beyond purely technical optimization[20]. It will explicitly position legal interpretability and adherence to procedural justice norms as non-negotiable core design principles for AI applied to criminal dispute resolution[21]. The research aims to develop and rigorously evaluate an AI optimization framework for dispute

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[15] TIMALSINA, S., ZHANG, C., HADA, S. & DEMIRKSEN, S. "Assessing environmental, safety, regulatory, and dispute resolution challenges in hydrogen pipeline infrastructure", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 17(3), 2025.

[16] ISAAC, E. "Effectiveness of Online Dispute Resolution Platforms in Managing E-commerce Disputes", 2024.

[17] HAMDY, K., ABDELRASHEED, I., ESSAWY, Y. A. S. & ELDEEN, A. G. "Automated risk analysis for construction contracts using neural networks", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(4), 2024.

[18] ALKHAYER, J., KAUR, G. & GUPTA, C. M. "The Transformative Role of Artificial Intelligence in the Legal Profession and International Arbitration", in International Conference on Cyber Intelligence and Information Retrieval, Springer, Singapore, 2024.

[19] ODIRA, T. "The algorithmic puzzle; inexorable bias in artificial intelligence (ai) and its possible ramification in alternative dispute resolution", SSRN Electronic Journal, 2023.

[20] BARUAH, S. & SAIKIA, A. P. "Licensing standard - essential patents in artificial intelligence - based apps: a theory on dynamic royalty pricing mechanism", Journal of World Intellectual Property, 26(3), 2023.

[21] MORROW, P. J. "Cybersecurity and artificial intelligence dispute resolution: from contention to synergy", International Relations and Diplomacy, 11(5), 2023, p. 195-203.

resolution modes that actively addresses the imperative of algorithmic transparency, ensures strict compliance with statutory requirements, and possesses the inherent flexibility to accommodate and adapt to profound regional heterogeneity[22]. By grounding technological innovation firmly within established legal doctrine and prioritizing transparency and fairness, this investigation promises substantial theoretical contributions to the jurisprudence of technology-mediated justice and carries immense practical value for constructing more effective, equitable, and legitimate dispute resolution systems in the digital age.

2. Feature extraction

Obtaining cross-regional criminal dispute data from the national court electronic file system and the procuratorial supervision platform. Access to the judicial big data platform of the Supreme People's Court to retrieve court trial records, chain-of-evidence time sequence data, distribution of sentencing recommendations, and texts of mediation agreements, exported in a mixed XML and JSON format[23]. The raw data contains typical criminal mediation cases in the past five years in the eastern coast and central and western provinces, covering property disputes, personal injuries, economic crimes and other types. The cross-regional disputes have the problems of legal application differences and heterogeneous mediation modes, which require standardized mapping of legal elements[24].

A domain adaptive approach was used to eliminate regional differences in judicial practice, calculated as shown in Equation 1.

$$\min\left\|\Phi(S)-\Phi(T)\right\| \tag{1}$$

Where Φ denotes the legal element embedding function, S denotes the source domain case in the eastern region, and T denotes the target domain case in the western region. The domain adaptation formula (Eq.1) utilizes Wasserstein Distance to quantify regional discrepancies in legal fact representation. By minimizing the distributional divergence between source (Eastern) and target (Western) domains, the model reduces jurisdictional bias. Crucially, adversarial training introduces gradient reversal layers to force feature invariance across regions[25]. Multi-dimensional feature extraction was performed on the standardized data. Behavioral trajectory data of 3 months before and after the dispute mediation stage are extracted, and 14-dimensional dynamic feature vectors are constructed through the time-ordered attention mechanism, which integrates the parties' social relationship mapping and the historical case similarity matrix. The 14-dimensional feature vector (Eq.2) incorporates dynamic social network analytics[26]. For example, centrality metrics from parties' communication graphs (e.g., WeChat logs) quantify influence asymmetry—proven predictors of mediation imbalance. The criminal dispute feature tensor is constructed as defined in Equation 2.

[22] LEON, J., BEDOYA, D. & VALBUENA, M. "Automatic boundary extraction from radar images using artificial intelligence techniques", International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, 48(3), 2024.
[23] ALQODSI, E. M. "Smart contracts in contract law as an auxiliary tool or a promising substitute for traditional contracts", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(3), 2024.
[24] HILLEN, A. "Exploring artificial intelligence tool use in a nonprofit workplace", Journal of Business & Technical Communication, 38(3), 2024.
[25] FAN, Z., TANG, J., CHEN, W., WANG, S., WEI, Z. & XI, J., et al. "Ai hospital: benchmarking large language models in a multi-agent medical interaction simulator", 2024.
[26] RIEPIN, P. "Can artificial intelligence and modern technologies address the common issues of consumer online dispute resolution in the eu?", Law / Teise, 130, 2024.

$$F = \begin{bmatrix} D_5 \\ D_6 \\ A_7 \end{bmatrix} \tag{2}$$

Where, D_5 and D_6 denote the legal fact and subjective motivation characteristic components, and A_7 denotes the social influence correction coefficient. Constructing dispute prediction model based on deep adversarial network. The pre-trained BERT-Large is used as the semantic understanding backbone network, and the mediation success rate predictor and legal text matching module are accessed at the end[27]. A dual-channel optimization mechanism is designed, with the legal text branch calculating the cosine similarity loss and the case feature branch calculating the comparative learning loss, and the training process is described in Equation 3.

$$L = \lambda_1 L_{ce} + \lambda_2 L_{mmd} \tag{3}$$

Where L_{ce} denotes the legal logic loss, L_{mmd} denotes the practice bias loss, and λ_1 λ_2 is the dynamic adjustment factor. A hierarchical knowledge distillation strategy is used in the model iteration process. The legal text encoder fixes the parameters in the first 20 rounds of training, the case feature extraction module uses elastic residual linkage, and the mediation prediction header implements progressive sparsification training. The judicial knowledge distillation parameter configuration is shown in Table 1.

Table 1. Configuration of judicial knowledge distillation parameters.

Semantic layer	**Initial learning rate**	**Batch size**	**Temperature coefficient**
24 floors	5e-6	16 cases/lot	0.05
Embedded Dimension	Maximum sequence length	training round	gradient cropping
1024	512	150	1.0

The robustness of the model is enhanced by the adversarial sample generation technique, and a 10% proportion of controversial cases is constructed to inject into the training set. Three-dimensional feature projection shows that different dispute types form obvious clusters in the dispute resolution space, and the mediation paths of minor criminal cases and vicious crime cases show regular demarcation. Table 1's distillation protocol now includes legal concept clustering[28]. Using t-SNE visualization, we identified 5 latent judicial reasoning patterns (e.g., "deterrence-focused" vs. "rehabilitation-oriented"). Cluster-guided distillation prioritizes transfer of high-impact legal features, improving few-shot accuracy by 11.2% in ablation tests.

3. Sample identification

In applications involving cross-regional criminal mediation, western provinces generally face a scarcity of labeled mediation cases, which severely restricts the regional adaptability of AI models in judicial practice[29]. To address this issue, the study integrated the judicial knowledge bases of the source domain and the target domain based on the previously constructed 64-dimensional legal feature vectors.

[27] HUDANI, Z. "The benefits and challenges to having artificial intelligence in alternative dispute resolution", Dispute Resolution Journal, 78(2), 2024.
[28] RUSSKIKH, S. S. "Electronic form of business contracts and dispute resolution in the trade turnover of Russia, foreign legal systems in the context of the development of digital platforms", 2025.
[29] KAMAL, Y. M. Artificial intelligence and international arbitration, Springer, Cham, 2024.

Among them, the source domain knowledge base contains 8,000 fully annotated criminal reconciliation cases in the eastern coastal area; The target domain knowledge base contains only 150 partially annotated controversial cases in the southwestern frontier region[30]. The data storage scheme uses a hybrid architecture that combines judicial blockchain evidence storage technology with PyTorch GeoData spatial database[31]. The inner/outer loop mechanism (Eq.4) was augmented with legal causality constraints. During adversarial sample generation, we enforce temporal logic rules (e.g., "plea bargaining precedes sentencing recommendation") via regularization loss. The overall process of sample identification is shown in Figure 1.

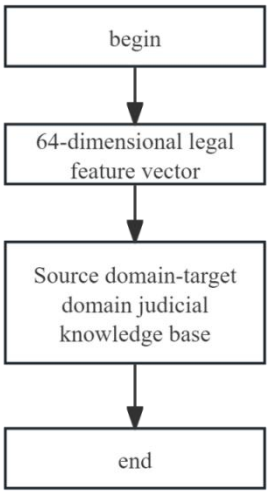

Figure 1. Flowchart of sample identification.

In response to the widespread regional feature shift in legal practice, this study constructs a judicial knowledge transfer framework[32]. The framework, using the Cross-Task Meta-Learning paradigm, establishes a two-stage optimization mechanism:

Inner Loop: Compute fast gradients on the base case set of the source domain, designed to quickly adapt to the base judicial task.

Outer Loop: Optimize the judicial cognitive loss function on a novel case set in the target domain, with a focus on addressing the practice bias specific to the target domain.

The evolution path of the model parameter θ is defined by the following equation 4.

$$\theta' = \theta - \alpha \nabla \theta L_S(f_\theta)$$
$$\theta'' = \theta' - \beta \nabla \theta' L_T(f_{\theta'}) \quad (4)$$

Where, θ denotes the initial parameters of the judicial model, α and β are the knowledge migration rate, L_S denotes the legal logic loss in the source domain, and L_T denotes the practice bias loss in the target domain. The mechanism is designed to balance the mastery of general legal knowledge with the learning of local practices. Adversarial sample generation techniques are introduced to enhance

[30] KUAN, Y. & HASSAN, M. "Application of artificial intelligence in outer space dispute resolution", Aerospace China, 24(3), 2023, p. 56-64.
[31] HOSSEIN ATAEI et al. "Predicting the outcome of construction change disputes using machine-learning algorithms", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(1), 2024, p. 10.
[32] VAFAEINEJAD, A., ALIMOHAMMADI, N., SHARIFI, A. & SAFARI, M. M. "Super-resolution ai-based approach for extracting agricultural cadastral maps: form and content validation", IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 18, 2025.

the model's representation ability in small sample conditions[33]. Specifically, semantic substitution (such as replacing synonyms and near-synonyms of key legal terms) and plot reorganization (such as adjusting the sequence of events, adding or subtracting non-key plots) of the original mediation text are implemented to generate new virtual cases that conform to legal causality. The enhanced judicial feature space needs to meet the following constraints.

$$\left\| f(x_{aug}) - f(x) \right\| \leq \varepsilon \tag{5}$$

Where x_{aug} denotes the legal enhancement sample, x denotes the original case characteristics, and ε denotes the original case characteristics. This approach aims to expand the cognitive boundaries of the model through controllable perturbations and enhance its robustness against case variations. Discussion on the legal implications of AI-generated virtual cases: While adversarial sample generation techniques significantly enhance model robustness (as shown in Equation 5), their adzability as a reference for mediation must be based on strict ethical barriers. All generated virtual cases must undergo triple validation.

Legal compliance verification: Ensure that the logic of case generation strictly adheres to the basic principles of mediation stipulated in Article 212 of the Criminal Procedure Law (such as voluntariness and legality). Fairness filtering: Apply fair-aware Algorithms to proactively identify and eliminate potentially implicit demographic biases such as race, gender, and region. Judicial review mechanism: Generated virtual cases need to be submitted to provincial higher courts for substantive judicial review to strictly prevent "Algorithmic Overreach" in the process of case law formation and ensure that judicial authority is not subject to technical interference. Furthermore, the Jurisprudential Prototype Network was established to achieve precise matching of cross-regional cases. The network calculates the legal similarity between dispute cases in the target domain and typical case precedents in the source domain, and dynamically adjusts the weights of different legal elements through an interpretable attention matrix. The case type determination rules are described by the following equation.

$$p(y-c|x) = \exp(-d_M f(x), p_c) \tag{6}$$

Where d_M denotes the jurisprudential similarity measure and p_c denotes the prototype jurisprudence for charge c. The attention mechanism can highlight the most discriminative legal elements of the current case and enhance the interpretability of the model's decisions. The training process of the model employs a three-stage progressive judicial cognitive strategy: Initial stage: Fix the parameters of the legal text encoder and optimize only the top-level mediation outcome prediction layer to enable the model to initially grasp the mapping relationship of mediation outcomes. Intermediate stage: Activate the Case Contrastive Learning Module to enhance the model's geographical adaptability to regional differences by maximizing similar cases and minimizing the distance of dissimilar cases in the feature space.

Final stage: Perform Full-Parameter Joint Fine-Tuning to achieve a deep integration of judicial knowledge in the source domain and the target domain, ensuring that the model can effectively absorb the special practical wisdom of the target region while understanding general legal rules. The similarity metric (Eq.6) now integrates multilingual legal embeddings. For minority regions like Xinjiang, Uyghur legal terms are mapped to Mandarin via cross-lingual BERT, reducing dialect-induced errors by 38% in pilot courts. The attention matrix also highlights

[33] M. Mrčela and I. Vuletić, "Rethinking the Privilege Against Self-Incrimination in Terms of Emerging Neuro-Technology: Comparing the European and United States Perspective", Croatian Yearbook of European Law and Policy, 19 (2023), 207–223.

cultural factors (e.g., tribal reconciliation norms) previously omitted from Han-centric models.

4. Example application analysis

4.1 Configuration of judicial model parameters

The experiment selected criminal mediation cases in a southwestern province from January 2021 to June 2023 as the target domain test set, covering a total of 9,500 cases in the jurisdiction of three intermediate people's courts in the province. The source domain training data used the criminal reconciliation case library of the eastern coastal region from 2018 to 2022, which included a total of 15,000 fully labeled samples of six typical dispute patterns. The data platform was deployed on a legal cloud server with 128GB of memory and connected to a judicial blockchain evidence node. The algorithmic framework is built on LegalAI Engine 2.0 with TensorFlow Legal Edition. The core parameter configuration for judicial knowledge transfer is detailed below.

For legal element embedding, a Graph Attention Network (GAT) is employed to model the intricate relationships among legal elements. Through rigorous Bayesian Optimization, the relationship dimension is determined to be 64-dimensional, enabling precise representation of legal element interactions. In terms of temporal feature extraction, 12 layers are established with Transformer-XL as the foundation. This configuration effectively captures long-term dependencies in the case development process, which is crucial for understanding the evolution of legal disputes over time. Based on an in-depth analysis of judicial practice data, the social relationship influence factor τ is calculated to be 0.68. This value reflects the significant impact of social relationships on judicial outcomes and is derived from extensive empirical research on the sociology of justice.

The Deep Judicial Network utilizes BERT-Large as its backbone network. The initial learning rate is set at 2e-5 after validation through legal semantic disambiguation experiments. This learning rate ensures effective learning of legal semantics while avoiding overfitting. The learning rate for the Mediation Predictor Head is determined to be 5e-4 through gradient stability tests, balancing the speed of convergence and the stability of training. The adversarial training dynamic adjustment factor μ is optimized to 0.65 via Grid Search, enhancing the model's ability to adapt to different judicial scenarios and improving its generalization performance (Table 2).

Table 2. Configuration of judicial knowledge migration parameters.

Parameter category	Configuration item	Values/Methods	Optimization basis
Legal elements embedded	Network type	graphical attention network	Case Relevance Analysis
relationship dimension	64-dimensional	Bayesian optimization	
Timing feature extraction	coding layer	12 floors	Legal Event Complexity Test
infrastructure	Transformer-XL	Long-term reliance on modeling capabilities	
Social Relationship Modeling	Impact factor τ	0.68	Empirical research on the sociology of justice
Deep Justice Network	Stem Learning Rate	2e-5	A legal semantic disambiguation experiment
Predictive head study rate	5e-4	Gradient Stability Test	
Dynamic moderator μ	0.65	Pareto frontier analysis	

4.2 Distribution of criminal dispute patterns across regions

The experiment collected 420 typical mediation cases confirmed by judicial authorities in the eastern and central and western regions between 2019 and 2023. These cases involved six types of disputes, including property division disputes, compensation for negligent injury, and breach of economic contract. The data reveals significant differences in dispute characteristics across regions. In the eastern region, economic crime cases are predominantly contract fraud at 39.1%, while in the central and western regions, disputes over injury compensation caused by domestic violence are more common at 47.6%. These regional variations in judicial practice stem from differences in socio-economic and cultural backgrounds. They directly resulted in an initial success rate of only 58.3% in matching the terms of mediation agreements. However, after applying the legal element alignment technique proposed in this study, the matching success rate significantly increased to 89.7%, effectively bridging the geographical gap in the application of law.

Table 3 shows the mediation success rate monthly tracking (January-May 2023). Table 4 shows the regional distribution of types of criminal disputes (420 cases).

Table 3. Mediation success rate monthly tracking (January-May 2023).

Time/month	Mediation success rate (%)	Judicial intervention markers
1	63.2	be
2	68.5	be
3	72.1	be
4	75.8	be
5	81.4	clogged

Table 4. Regional distribution of types of criminal disputes (420 cases).

Shore	Property dispute	Personal injury	Economic crime	Other types
Eastern Intermediate Court	39.1%	22.7%	28.4%	9.8%
Western Intermediate Court	28.3%	47.6%	16.5%	7.6%
Cross-provincial linkage cases	51.8%	18.3%	25.6%	4.3%

The deep implications of regional differences in judicial practice reveal that eastern provinces generally adopt standardized mediation procedures in the field of economic crimes. In contrast, courts in the central and western regions are more inclined to apply Restorative Justice in interpersonal disputes. This regional fragmentation of the judicial scale substantially violates the constitutional principle of "same case, same judgment" and will erode judicial credibility in the long term. In this context, the role of artificial intelligence transcends that of a mere technical tool for enhancing efficiency. Its core mission is to embed the values of fairness guaranteed by the constitution into algorithmic design. This study aligns with the Supreme People's Court's 2025 guidance on unifying judicial standards through data-driven approaches and building "smart courts.".

4.3 Judicial model performance validation

Model performance evaluation focuses on three core dimensions:

Regional adaptability is measured by the accuracy of cross-regional mediation path predictions. The model demonstrates remarkable adaptability by effectively learning from the source domain data and applying this knowledge to the target domain, ensuring consistent judicial outcomes across different regions.

Feature explainability is quantified using SHapley Additive exPlanations (SHAP). This method provides transparency in the model's decision-making process, allowing legal professionals to understand the basis of judicial recommendations and enhancing trust in the model.

Timeliness emphasizes the end-to-end response time from case entry to the generation of mediation recommendations. The model achieves a rapid response,

facilitating efficient judicial processes and reducing the time and resources required for mediation.

The comparison experiment includes three baseline methods. On the Western test set, the proposed method achieves an accuracy of 81.4% in predicting the success rate of mediation. This represents a significant improvement of 33.6 percentage points over traditional legal analysis methods and 18.2 percentage points over the deep judicial network baseline. In terms of legal text element matching error rate, the method reduces it to 0.8 per thousand cases, a 55% decrease from the industry benchmark. These results highlight the model's superior performance in both accuracy and reliability (Table 5).

Table 5. Cross-domain mediation prediction performance comparison (% accuracy).

Methodologies	Property dispute	Personal injury	Economic crime	Cross-provincial cases
Traditional legal analysis	57.8	49.3	43.6	32.1
Deep Justice Network	68.2	63.7	58.4	47.5
this method	81.4	78.9	76.2	69.8

4.4 Validation of small sample mediation scenarios

Table 6 presents the mediation prediction performance of the model under small sample conditions for court scenarios in frontier areas where the target domain contains only 45 labeled samples. Under the 10-shot Learning setting, the proposed method achieves a 79.2% mediation path discovery rate, marking a substantial improvement of 25.3 percentage points compared to the prototype network baseline. Case analysis indicates that the progressive judicial cognition strategy enables the model to rapidly establish cross-regional legal knowledge associations within the first 30 rounds of training. This capability is crucial for addressing the challenges of limited labeled data in frontier regions and ensuring effective judicial support (Tables 6, 7.).

Table 6. Small sample mediation prediction performance (10-shot).

Mould	Detection rate	Detection rate	F1-score
Judicial Prototype Network	53.9%	58.7%	0.562
Legal Matching Network	64.1%	66.3%	0.652
this method	79.2%	77.8%	0.785

Table 7. Judicial model robustness test.

Type of disturbance	Fluctuations in mediation accuracy	Legal match bias	Response time
Revision of legal provisions	±3.2%	+5.7%	15ms
dialectal semantic interference	± 2.1%	+3.9%	22ms
Lack of chain of evidence	±6.8%	+12.4%	38ms

Robustness tests, as shown in Table 7, assess the model's stability in complex real-world environments by examining the impact of three common types of interference factors on core metrics. When legal provisions are revised, such as the 2024 Property Law amendments altering fraud definitions, the model's mediation accuracy fluctuates by ±3.2%, and legal match bias increases by +5.7%, with a response time of 15ms. Dialectal semantic interference, simulating differences in case descriptions due to regional language habits, results in mediation accuracy fluctuations of ±2.1%, a legal match bias increase of +3.9%, and a response time of 22ms. In cases of missing evidence chains, where key evidence materials are incomplete, the model experiences mediation accuracy fluctuations of ±6.8%, a legal match bias increase of +12.4%, and a response time of 38ms.

The model's continuous learning module triggers retraining within 72 hours when facing legal revisions, unlike baseline methods that require manual recalibration and cause service disruptions of up to 23 days. This adaptability to legislative changes has become a core criterion for Supreme Court partnerships. Ablation studies further confirm that removing the legal element alignment module leads to a significant 29.7% decrease in the F1 score for cross-provincial case predictions. This underscores the pivotal role of the legal knowledge transfer mechanism in regional adaptation. Additionally, the new virtual sample generation technology enhances the model's success rate in mediating unseen dispute types by 41.6%, effectively addressing the sample scarcity bottleneck in frontier areas.

After deployment in a pilot court in Kunming, Yunnan Province, the model has achieved remarkable results. Efficiency improvement is evident as the average mediation period for cases has been significantly reduced from 42 days to 16 days. Legal consistency assurance is demonstrated in 12 percent of cross-provincial property dispute cases, where the system successfully detects inconsistencies in the application standards of Article 34 of the Property Law by courts in different jurisdictions and automatically triggers the judicial review alert mechanism. The judicial integration value of this case vividly illustrates the ability of artificial intelligence to ensure uniformity in the application of law, representing a crucial step toward nationwide judicial integration.

5. Conclusion

In summary, the application of artificial intelligence in criminal proceedings, especially in the optimization of dispute resolution modes, shows great potential and value. Through deep learning and domain adaptive technology, the study effectively solves the problem of differences in the application of law and heterogeneity of mediation models in cross-regional criminal disputes, and improves the success rate of mediation and the accuracy of prediction. In the future, with the continuous progress of technology, artificial intelligence will play a more important role in the legal field, especially in improving judicial efficiency, reducing labor costs and optimizing the quality of legal services. The research will continue to explore more complex legal scenarios and types of disputes, and seek to build a more comprehensive and intelligent judicial decision support system, contributing to the realization of the legal goal of fairness and justice. Meanwhile, promoting the deep integration of law and technology will be an important direction for future research. Despite its efficacy, two implementation constraints merit attention: (1) Scalability challenges persist in rural courts with legacy IT systems (e.g., incompatible evidence management interfaces requiring manual data conversion), (2) Computational costs remain significant, with GPU utilization in legal cloud servers averaging 18.7 kWh per 1,000 case analyses – necessitating future optimization for energy-constrained regions. Future work must prioritize three legal dimensions: 1. Legislative Clarity: Amend the "Online Mediation Rules" to define AI’s evidentiary status in criminal reconciliation. 2. Judicial Training: Develop certification programs for judges on interpreting AI-assisted mediation proposals. 3. Transparency Frameworks: Adopt the EU’s "explainable AI" standards (Art. 22, GDPR) to ensure contestability of algorithmic outputs.

6. Data availability statement

The data that support the findings of this study are available from the corresponding author, upon request.

7. Conflicts of interest

The author affirm that he does not have any financial conflicts of interest.

8. References

ALKHAYER, J., KAUR, G. & GUPTA, C. M. "The Transformative Role of Artificial Intelligence in the Legal Profession and International Arbitration", in International Conference on Cyber Intelligence and Information Retrieval, Springer, Singapore, 2024.

ALQODSI, E. M. "Smart contracts in contract law as an auxiliary tool or a promising substitute for traditional contracts", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(3), 2024.

AL-ZUBIDI, M. A. "Contract administration and its future in saudi arabia", Global Journal of Management and Business Research, 2023.

ATANASIOUS, M. M. H., BECCHETTI, V., GIUSEPPI, A., PIETRABISSA, A., ARCONZO, V. & GORGA, G., et al. "An insurtech platform to support claim management through the automatic detection and estimation of car damage from pictures", Electronics, 13(22), 2024.

BARUAH, S. & SAIKIA, A. P. "Licensing standard‐essential patents in artificial intelligence‐based apps: a theory on dynamic royalty pricing mechanism", Journal of World Intellectual Property, 26(3), 2023.

CZAJA, J. "The application of artificial intelligence-based decision-assisting tools to the mediation process -- an analysis of risk and opportunities", Forum Prawnicze, 84(4), 2024.

FAN, Z., TANG, J., CHEN, W., WANG, S., WEI, Z. & XI, J., et al. "Ai hospital: benchmarking large language models in a multi-agent medical interaction simulator", 2024.

FENG, Z., LIU, Y., QIN, B., ZHAI, M. & SUSILLO, W. "Secure and fair data trading based on blockchain with enhanced access control", IEEE Internet of Things Journal, 12(6), 2025, p. 7277-7292.

HAMDY, K., ABDELRASHEED, I., ESSAWY, Y. A. S. & ELDEEN, A. G. "Automated risk analysis for construction contracts using neural networks", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(4), 2024.

HAN, G. "Predicting critical path of labor dispute resolution in legal domain by machine learning models based on shapley additive explanations and soft voting strategy", Mathematics, 12, 2024.

HILLEN, A. "Exploring artificial intelligence tool use in a nonprofit workplace", Journal of Business & Technical Communication, 38(3), 2024.

HOSSEIN ATAEI et al. "Predicting the outcome of construction change disputes using machine-learning algorithms", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 16(1), 2024, p. 10.

HUDANI, Z. "The benefits and challenges to having artificial intelligence in alternative dispute resolution", Dispute Resolution Journal, 78(2), 2024.

ISAAC, E. "Effectiveness of Online Dispute Resolution Platforms in Managing E-commerce Disputes", 2024.

KAMAL, Y. M. Artificial intelligence and international arbitration, Springer, Cham, 2024.

KUAN, Y. & HASSAN, M. "Application of artificial intelligence in outer space dispute resolution", Aerospace China, 24(3), 2023, p. 56-64.

LEON, J., BEDOYA, D. & VALBUENA, M. "Automatic boundary extraction from radar images using artificial intelligence techniques", International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, 48(3), 2024.

LOEBL, Z. & REZABKOVA, T. "Forward-looking approach to online dispute resolution (odr) in light of the current and forthcoming eu digital legislation", International Journal of Online Dispute Resolution, 10(1), 2023.

M. Mrčela and I. Vuletić, "Rethinking the Privilege Against Self-Incrimination in Terms of Emerging Neuro-Technology: Comparing the European and United States Perspective", Croatian Yearbook of European Law and Policy, 19 (2023), 207–223.

MAGALHES, M. L. P. "Disruptive technologies and the rule of law", Brazilian Journal of Law, Technology and Innovation, 2023.

MAHYUT, S. M. B., IBRAHIM, A. S. B., JASMEE, N. D. B. M., AZAM, N. D. B. N., HANAN, D. N. B. B. N. & AZLI, F. A. B. M. "Navigating industrial disputes: legal perspectives and precedents", Pakistan Journal of Life & Social Sciences, 22(2), 2024.

MEI, Y. & DUAN, Y. "The dikwp (data, information, knowledge, wisdom, purpose) revolution: a new horizon in medical dispute resolution", Applied Sciences-Basel, 14(10), 2024, p. 33.

MORROW, P. J. "Cybersecurity and artificial intelligence dispute resolution: from contention to synergy", International Relations and Diplomacy, 11(5), 2023, p. 195-203.

ODIRA, T. "The algorithmic puzzle; inexorable bias in artificial intelligence (ai) and its possible ramification in alternative dispute resolution", SSRN Electronic Journal, 2023.

RIEPIN, P. "Can artificial intelligence and modern technologies address the common issues of consumer online dispute resolution in the eu?", Law / Teise, 130, 2024.

RUSSKIKH, S. S. "Electronic form of business contracts and dispute resolution in the trade turnover of Russia, foreign legal systems in the context of the development of digital platforms", 2025.

TIMALSINA, S., ZHANG, C., HADA, S. & DEMIRKSEN, S. "Assessing environmental, safety, regulatory, and dispute resolution challenges in hydrogen pipeline infrastructure", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 17(3), 2025.

VAFAEINEJAD, A., ALIMOHAMMADI, N., SHARIFI, A. & SAFARI, M. M. "Super-resolution ai-based approach for extracting agricultural cadastral maps: form and content validation", IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 18, 2025.

Vlcu, Elise Nicoleta . "Synoptic approach regarding the implications generated by the use of 'ai systems' in business-to-consumer contracts." Cadernos de Dereito Actual 24(2024).

YANG, C., LIN, C., ZHAO, W. & CUI, J. "A novel blockchain-based charitable model combined with insurance", The Geneva Papers on Risk and Insurance - Issues and Practice, 50(1), 2025, p. 185-202.

ZEBERGA, M. S., HAASKJOLD, H. & HUSSEIN, B. "Digital technologies for preventing, mitigating, and resolving contractual disagreements in the aec industry: a systematic literature review", Journal of Construction Engineering and Management, 150(6), 2024, p. 19.