AI-Assisted Peer Review

1. Introduction

The growing number of manuscript submissions places significant strain on the peer review process. AI is being explored as a solution to automate aspects of peer review, such as plagiarism detection, format compliance, and reviewer-paper matching. This study investigates AI's effectiveness in predicting peer review outcomes and detecting biases.

Key Research Questions:

1. Can AI approximate human decisions in peer review?
2. Can AI reduce the time required for peer review?
3. Can AI detect biases in the review process?
4. What are the ethical implications of AI-assisted review?

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2. Peer Review Process & AI's Role

Figure 1 illustrates the different stages of peer review and where AI can be applied.

Figure 1: AI Integration in the Peer Review Process

- **Pre-screening:** Formatting checks, plagiarism detection, readability assessment.
- **Peer Review:** AI-assisted quality assessment, bias detection.
- **Post-publication:** AI-driven post-review analysis.

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3. Methodology

3.1 Data Collection

The study analyzed **3,300 papers** from the following conferences:

- **WCNC 2018 (IEEE Wireless Communications & Networking Conference)**

- **ICLR 2018 (International Conference on Learning Representations)**
- **ICLR 2019**

Table 1: Summary of Collected Datasets

Dataset	Papers	Avg Review Score	Acceptance Rate
WCNC 2018	1,018	3.01	48.9%
ICLR 2018	909	5.45	37.1%
ICLR 2019	1,414	5.43	35.6%

3.2 AI Model Features

The AI model was trained using:

- **Word distribution**: Frequency of key terms.
- **Readability metrics**: Sentence complexity, vocabulary difficulty.
- **Formatting features**: Document length, number of pages, image/text ratio.

Table 2: Readability Features Used in AI Model

Feature Name	Description
Flesch-Kincaid Score	Measures text readability.
Sentence Complexity Index	Analyzes sentence structure.

Word Frequency Distribution	Examines key term usage.

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4. Results

4.1 AI Performance in Predicting Review Outcomes

- **For WCNC 2018:** AI achieved **74% accuracy** in predicting acceptance/rejection.
- **For ICLR datasets:** AI predicted reviewer scores with **Mean Absolute Error (MAE) of 0.79** on a 10-point scale.

Table 3: AI Model Performance vs. Baseline

Dataset	AI Accuracy	Random Accuracy
WCNC 2018	74.01%	~50%
ICLR 2018/19	MAE: 0.79	MAE: 0.96

Figure 2: Distribution of Review Scores for Accepted vs. Rejected Papers

AI found strong correlations between **formatting, readability, and acceptance decisions.**

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5. Ethical Concerns & Bias Detection

5.1 Identified Biases

- **Language Bias**: Non-native English papers may be unfairly penalized.

- **Institutional Bias**: Papers from underrepresented regions face higher rejection rates.
- **Formatting Bias**: Well-structured but low-quality papers may be favored.

Figure 3: AI Model Decision Influences (Bias Detection)

5.2 Ethical Challenges

- **AI's opacity** makes it hard to trust review decisions.
- **Algorithmic bias** could reinforce existing inequalities.
- **Reviewer influence**: AI predictions may unconsciously sway human reviewers.

Table 4: AI's Impact on Different Review Dimensions

Dimension	AI's Role
Formatting	High
Plagiarism	High
Readability	Medium
Relevance	Medium
Soundness	Low

6. Conclusion & Future Work

6.1 Key Findings

- AI **can predict** review outcomes with moderate accuracy.
- AI **exposes biases** in the review process.
- AI **is not a replacement** for human reviewers but can assist in screening.

6.2 Future Research Directions

1. **Human-AI Interaction:** Understanding how AI influences reviewer decisions.
2. **Textual Analysis:** Using full review texts to enhance AI predictions.
3. **Discipline-Specific Models:** Exploring AI's role in different academic fields.
4. **AI for Grant Reviews:** Extending the study to funding proposal evaluations.