**Title: Exponential stability** of switched stochastic delay systems with **non-linear uncertainties**
**Abstract:** This article considers the robust **exponential stability** of uncertain switched stochastic systems with time-delay. Both almost sure (sample) stability and stability in mean square are investigated. Based on Lyapunov functional methods and **linear matrix inequality** techniques, new criteria for exponential robust stability of switched stochastic delay systems with **non-linear uncertainties** are derived in terms of linear matrix inequalities and **average dwell-time** conditions. Numerical examples are also given to illustrate the results.

**(a)** Present Keyphrases
**Target:** {stochastic systems; non-linear uncertainties; exponential stability; linear matrix inequality; average dwell-time}
**CopyRNN:** 1. **linear matrix inequality**, 2. switched stochastic systems, 3. robust stability, 4. **exponential stability**, 5. **average dwell-time**
**TG-Net:** 1. **exponential stability**, 2. switched stochastic systems, 3. **average dwell-time**, 4. **non-linear uncertainties**, 5. **linear matrix inequality**

**(b)** Absent Keyphrases
**Target:** {switched systems; time-delay system}
**CopyRNN:** 1. **switched systems**, 2. switched delay systems, 3. robust control, 4. uncertain systems, 5. switched stochastic stochastic systems
**TG-Net:** 1. almost sure stability, 2. **switched systems**, 3. **time-delay systems**, 4. mean square stability, 5. uncertain systems

Figure 4: A prediction example of CopyRNN and TG-Net. The top 5 predictions are compared and the correct predictions are highlighted in bold.

| | Present | | Absent | |
|---|---|---|---|---|
| **Model** | F1@5 | F1@10 | R@10 | R@50 |
| TG-Net | **0.349** | **0.295** | **0.146** | **0.253** |
| -title | 0.334 | 0.288 | 0.142 | 0.240 |
| -copy | 0.306 | 0.281 | 0.127 | 0.216 |

Table 5: Ablation study on **Krapivin** dataset.

As shown in Table 5, after we remove the title-guided part and only reserve the sequence encoding for the context (i.e., -title), both the present and absent keyphrase prediction performance become obviously worse, indicating that our title-guided context encoding is consistently critical for both present and absent keyphrase generation tasks. We also investigate the effect of removing the copy mechanism (i.e., -copy) from our TG-Net. From Table 5, we notice that the scores decrease dramatically on both present and absent keyphrase prediction, which demonstrates the effectiveness of the copy mechanism in finding important parts of the context.

## Case Study

A keyphrase prediction example for a paper about the exponential stability of uncertain switched stochastic delay systems is shown in Figure 4. To be fair, we also only compare the RNN-based models (i.e., TG-Net and CopyRNN). For present keyphrase, we find that a present keyphrase "non-linear uncertainties", which is a title phrase, is correctly predicted by our TG-Net, while CopyRNN fails to do so. As for absent keyphrase, we note that CopyRNN fails to predict the absent keyphrase "time-delay systems". But our TG-Net can effectively utilize the title information "stochastic delay systems" to locate the important abstract information "stochastic systems with time-delay" and then successfully generate this absent keyphrase. These results exhibit that our model is capable of capturing the title-related core information more effectively and achieving better results in predicting present and absent keyphrases.

## Conclusion

In this paper, we propose a novel TG-Net for keyphrase generation task, which explicitly considers the leading role of the title to the overall document main body. Instead of simply concatenating the title and the main body as the only source input, our model explicitly treats the title as an extra query-like input to guide the encoding of the context. The proposed TG-Net is able to sufficiently leverage the highly summative information in the title to guide keyphrase generation. The empirical experiment results on five popular real-world datasets exhibit the effectiveness of our model for both present and absent keyphrase generation, especially for a document with very low or very high title length ratio. One interesting future direction is to explore more appropriate evaluation metrics for the predicted keyphrases instead of only considering the exact match with the human labeled keyphrases as the current *recall* and *F-measure* do.

## Acknowledgments

The work described in this paper was partially supported by the Research Grants Council of the Hong Kong Special Administrative Region, China (No. CUHK 14208815 and No. CUHK 14210717 of the General Research Fund), and Microsoft Research Asia (2018 Microsoft Research Asia Collaborative Research Award). We would like to thank Jingjing Li, Hou Pong Chan, Piji Li and Lidong Bing for their comments.

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