Alternate *ACM* SIG Proceedings Paper in LaTeX Format*

[Extended Abstract] †

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ABSTRACT

This project main goal is to refine a method, called the GAModel, to obtain better accuracy in seismic prediction. The GAModel is a model which aims to generate forecasts by using only Evolutionary Computation (EC).

This document sumamarizes the GAModel and proposes three extended versions for the GAModel. The first model,ReducedGAModel, is similar to the GAModel, tough it has a different genotype representation. In the GAModel the genotype is related with the fenotype, and in ReducedGAModel the genotype is a version non-related with the fenotype. The second model named as Emp-ReducedGAModel, as the reducedGAModel, uses this new genotype idea and incomporates some emperical laws such as the modified Omori-Utsu formula. The last one, the Emp-GAModel, recovers the genotype-fenotype relation from the GAmodel but also incomporotes the same emperical laws that composes the ReducedGAModel.

These four models were evaluated and compared based on the predictabily experiments framework proposed by the "Collaboratory for the Study of Earthquake Predictability" (CSEP), an international effort to standardize the study and testing of earthquake forecasting models. The experiments were designed to compare 1-year earthquake rate forecasts for four regions in Japan in using the data from the Japan Meteorological Agency (JMA) earthquake catalog.

Keywords

Evolutionary Computation, Genetic Algorithms, Forecasting, Earthquakes

1. INTRODUCTION

Earthquakes may cause soil rupture or movement, tsunamis and more. They may cause great losses and that can be explicit by some examples such as the earthquakes in Tohoku (2011) and Nepal(2015). To be able to minimize the consequences of these events, we look to create forecast earthquake occurences models. Hence the characteristics of the earthquakes may vary both in time and place, these models should be to adapt their behavior to be able to forecast earthquakes which follows the reality.

This project aims to add significant improvements to the GAModel, a statistical method of analysis of earthquakes risk using the Genetic Algorithm technique (GA). Earthquakes cluster in both space and time, and the ideia is to apply Genetic Algorithm technique (GA) with a some empirical laws, such as the modified Omori law. First, the background intensity (the independent earthquakes), which is a function of the space, is forecasted using the GA. Then, we use some empirical laws to obtain the dependent earthquakes for a specific time interval.

A common problem with applications of evolu- tionary algorithms is how to compare different meth- ods, developed by different groups with different test- ing protocols, in a scientific fashion. We survey and summarize the âĂIJbest practicesâĂİ for the studying and testing of earthquake forecast models, as suggested by the Collaboratory for the Study of Earthquake Predictability (CSEP), an international partnership to promote rigorous study of the feasibility of earth-

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†A full version of this paper is available as *Author's Guide to Preparing ACM SIG Proceedings Using $\LaTeX2_\epsilon$ and BibTeX* at `www.acm.org/eaddress.htm`

‡Dr. Trovato insisted his name be first.

§The secretary disavows any knowledge of this author's actions.

¶This author is the one who did all the really hard work.

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quake forecasting and predictability. Based on this framework, we design and imple- ment a simple Genetic Algorithm for earthquake fore- cast modeling (GAModel). We compare forecasts generated by the GAModel with the Relative Inten- sity algorithm (RI) and an information-less forecast. These systems are applied on the earthquake catalog from the Japanese Meteorological Agency (JMA), us- ing event data from 2005 to 2012. The forecasts are analyzed by their log-likelihood values compared to the actual data, as suggested in the Regional Earth- quake Likelihood Model (RELM), and by the Area Skill Score (ASS) test.

The models resulted of those methods were analyzed using likelihood tests, as suggested by Regional Earthquake Likelihood Model (RELM) (Schorlemmer et al., 2007).

2. THE *BODY* OF THE PAPER

3. MODELS

4. TESTS - L, N, R

5. RESULTS

6. EXPERIMENTS

7. RESULTS

8. CONCLUSION

9. CONCLUSIONS

This paragraph will end the body of this sample document. Remember that you might still have Acknowledgments or Appendices; brief samples of these follow. There is still the Bibliography to deal with; and we will make a disclaimer about that here: with the exception of the reference to the LaTeX book, the citations in this paper are to articles which have nothing to do with the present subject and are used as examples only.

10. ACKNOWLEDGMENTS

This section is optional; it is a location for you to acknowledge grants, funding, editing assistance and what have you. In the present case, for example, the authors would like to thank Gerald Murray of ACM for his help in codifying this *Author's Guide* and the **.cls** and **.tex** files that it describes.

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12. REFERENCES

APPENDIX

A. HEADINGS IN APPENDICES

The rules about hierarchical headings discussed above for the body of the article are different in the appendices. In the **appendix** environment, the command **section** is used to indicate the start of each Appendix, with alphabetic order designation (i.e. the first is A, the second B, etc.) and a title (if you include one). So, if you need hierarchical structure *within* an Appendix, start with **subsection** as the highest level. Here is an outline of the body of this document in Appendix-appropriate form:

A.1 Introduction

A.2 The Body of the Paper

A.2.1 Type Changes and Special Characters

A.2.2 Math Equations

Inline (In-text) Equations.

Display Equations.

A.2.3 Citations

A.2.4 Tables

A.2.5 Figures

A.2.6 Theorem-like Constructs

A Caveat for the TeX Expert

A.3 Conclusions

A.4 Acknowledgments

A.5 Additional Authors

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A.6 References

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B. MORE HELP FOR THE HARDY

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