



UNIVERSITY OF AGDER

Difficulty Scaling of Game AI

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Abstract:

Something about us reviewing an article and its contents. Highlight the background and why the article is important.

1 Preface

This is a report for IKT426 - Research Seminar at the University of Agder, spring of 2013.

We would like to acknowledge Sondre Glimsdal, for supervising the writing of this report.

- Jon Vegard Jansen and Robin Tollisen, 4th of May 2013.

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4 Introduction

This report will discuss the paper "Difficulty Scaling of Game AI", by Pieter Spronck, Ida Sprinkhuizen-Kuyper and Eric Postma, 2004. Artificial intelligence will henceforth be abbreviated AI. This problem is a hard problem to solve, as game AI usually cannot be approached the same way as regular AI, trying to make them as smart as possible, but has to make mistakes for the player to beat them.

The problem discussed in the paper by Spronck et al. is how you can adapt the difficulty of a game AI in real time. The difficulty in this case is how hard it would be for a player to win at the game. The main in this field is scaling the difficulty of the AI to produce what is referred to in the paper as "even games", which means that the player should not win 100% of the time, or if he does, for instance if the game requires it e.g. roguelikes[1] with premanent death, it should not be easy for the player to win 100% of the time.

This paper will discuss Difficulty Scaling of Game AI [2], we have also read and may take elements from [3] which is the paper where they explain the method they use in the main paper.

5 The Paper - Difficulty Scaling of Game AI

We will go through the paper mostly one headline at a time. First, we present the paper abstract, as it outlines the background and problems very well, and the rest of the article follows its structure.

5.1 Paper Abstract

The abstract of the paper is as follows:

"'Difficulty scaling' is the automatic adaptation of a game, to adapt the challenge a game poses to a human player. In general, a game of which the challenge level matches the skill of the human player (i.e., an "even game") is experienced as more entertaining than a game that is either too easy or too hard. In practice, when difficulty scaling is implemented in a game, it only adapts a few parameters. Even state-of-the-art games do not apply it to game AI, i.e., to the behaviour of computer-controlled opponents in a game. In prior work, we designed a novel online-learning technique called "dynamic scripting", that is able to automatically optimise game AI during game-play. In the present paper, we research to what extent dynamic scripting can be used to adapt game AI in order to elicit an even game. We investigate three difficulty-scaling enhancements to the dynamic scripting technique, namely high-fitness penalising, weight clipping, and top culling. Experimental results indicate that top culling is particularly successful in creating an even game. We conclude that dynamic scripting, using top culling, can enhance the entertainment value of games by scaling the difficulty level of the game AI to the playing skill of the human player." NEED REF

Firstly, the abstract defines what difficulty scaling is, and its purpose. Since many computer games use computer-controlled opponents to challenge the player, the purpose of difficulty scaling is to make these challenges as even as possible, as this is often viewed as "more entertaining". Secondly, the abstract claims that state-of-the-art difficulty scaling is not applied to the behavior of game AI but rather to more simple parameters. In order to change this, the group has previously "designed a novel online-learning technique called 'dynamic scripting'". This technique is described in their prior paper, mentioned in the introduction. (REF!) Thirdly, the abstract explains three "difficulty-scaling enhancements", which is added to dynamic scripting, in order to make even games. Lastly, the abstract concludes that the technique called 'top culling' is the best for using dynamic scripting to create even games.

5.2 Paper Structure

The structure of the paper is resembling the structure of the abstract, starting out with an introduction, motivating the need for difficulty scaling, as well giving some background on dynamic scripting. Then, the paper starts explaining difficulty scaling and the three techniques used to enhance dynamic scripting, namely high-fitness penalising, weight clipping and top culling. After the theory is given, a few experiments are shown, before the discussion and conclusion states that top culling is the better of the three techniques.

5.3 Dynamic Scripting

5.4 Difficulty Scaling

This section starts out by first describing how many games deal with players on different levels, that is by setting different, discrete difficulty settings, such as 'easy, normal and hard'. These settings usually does not affect the behavior of the game AI, only their relative strength to the player, maybe even in an unfair or cheating way. This paper presents how the difficulty level can adapt to the player as the game is played, not only by changing relative strength numbers, but also by allowing the game AI to change tactics.

5.5 Techniques

Based on dynamic scripting, the paper presents three different enhancement techniques, which will make the game AI adapt its level more closely to the human player. The first technique is high-fitness penalising, which gives more rewards to mediocre fitness values, instead of optimal ones, using the following formula:
@figure(high-fitness_penalising2, high-fitness_penalising2.png, High-fitness penalising formula)

5.6 Paper Experiments and Discussion

5.7 Paper Conclusion and Future Work

6 Discussion

7 Conclusion

8 References

- [1] <http://en.wikipedia.org/wiki/Roguelike>
- [2] <http://www.dcc.ru.nl/~idak/publications/papers/SpronckGAMEON2004.pdf>
- [3] Rewrite to proper style, ONLINE ADAPTATION OF GAME OPPONENT AI WITH DYNAMIC SCRIPTING, published in the International Journal of Intelligent Games and Simulation, page 45-53, by Pieter Sprock et al.