Computational Intelligence Algorithms for the Development of an Artificial Sport Trainer

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Thesis summary

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This paper presents a short summary of doctoral thesis that proposes the use of computational intelligence algorithms for the development of an Artificial Sport Trainer.

Povzetek: Članek predstavlja kratko vsebino doktorske disertacije, ki predlaga uporabo algoritmov računske inteligence za razvoj umetnega športnega trenerja.

1 Introduction

Planning the proper sport training sessions for athletes is a very hard problem for sports trainers. With the rising computational power on the one hand, and emerging data warehouses on the other, new algorithms for discovering knowledge from these data have emerged. An overview of literature in this domain showed that there is still a lack of algorithms for knowledge enrichment from data that are based explicitly on computational intelligence [1]. Interestingly, there were some solutions that applied artificial neural networks for controlling the sports training sessions (e.g. [5, 6]) and even fuzzy logic [7]. However, almost none of the studies suggested the use of population-based nature-inspired algorithms [4] (e.g., evolutionary algorithms, or swarm intelligence algorithms) for these tasks. Contrary, the thesis [3] proposes a concept of an intelligent system called **Artificial Sport Trainer** (AST) for the training purposes of athletes. AST is based on stochastic population-based nature-inspired algorithms, designed to cover all phases of the sports training, which are also in the domain of a real sport trainer: planning, realization, control and evaluation.

The thesis is divided into two parts. The first, theoretical part, presents the fundamentals of computational intelligence, basics of sports training and the architecture of the AST. The second, experimental part, presents two applications of the AST. The former is devoted to planning sports training sessions based on existing sports activities, e.g. comprehensive performance study of six different stochastic, nature-inspired population-based algorithms (Bat Algorithm (BA), Differential Evolution (DE), Firefly Algorithm (FA), Hybrid Bat Algorithm (HBA), self-adaptive Differential Evolution (jDE) and Particle Swarm Optimization (PSO)). These algorithms were tested on three real datasets, i.e. professional cyclist, amateur cyclist and semi-professional runner. The latter proposes a solution for Association Rule Mining (ARM) based on BA (the so-called BatMiner), which is applied to real datasets for finding cyclist's characteristics during the sports training.

2 Artificial sport trainer

The main architecture of the AST [2] covers the following phases of the sport training:

- Planning: the most important phase of the sport training, that consists of:
  - long-term planning (so-called strategy) and
  - short-term planning (so-called tactics).
- Realization: this phase captures the realization of the sports training session.
- Control: realization of the sports sessions is typically controlled by wearable devices, such as sports watches or smart-phones.
- Evaluation: after the conducted training plan, the expected form or abilities of an athlete are evaluated.

3 Experiments and results

In order to confirm that the AST can be used in practice, we have conducted a comprehensive experimental work that includes mentioned six different algorithms (i.e., BA, DE, FA, HBA, jDE, PSO) on three real datasets obtained by different kinds of athletes (i.e., professional, semi-professional and amateur) in two sports (i.e. cycling, running). Additionally, we have also studied the influence of clusters that was obtained by k-means clustering. We have used the following numbers of clusters: 5, 8, 10, 12,

15, and 18. The second application was tested on a real cyclist's dataset and was compared to the Hybrid Binary Cuckoo Search for ARM. Resulting plans of the first application have then been compared to the plans, created by a real sport trainer. Comparison showed that the AST can be used for planning sport trainings sessions, according to the TRIMP indicator with confidence of 0.1. The results of the second application showed that a BatMiner is an appropriate algorithm for finding characteristics of athletes during the sports training.

4 Conclusion

Main findings of the thesis [3] are: (1) A new research area is proposed, i.e., use of computational intelligence algorithms in the sport area, (2) The concept of an **Artificial Sport Trainer** encompasses various algorithms of computational intelligence in sport, (3) New population-based nature-inspired algorithms for planning sport training sessions are developed and validated on the real data obtained by two cyclists and one runner, (4) An easy metric for comparing AST's and real trainer's session plans is proposed and (5) The BatMiner algorithm for mining characteristics of athletes during the sports training sessions is built.

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