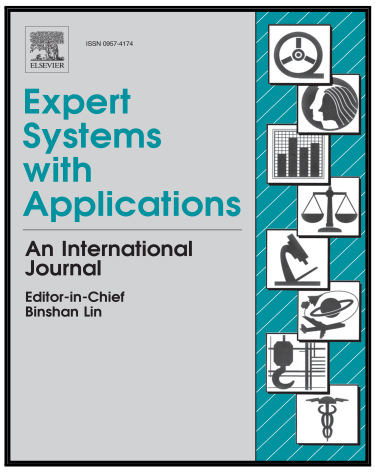

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Measuring the Emotional State Among Interacting Agents: A Game Theory Approach Using Reinforcement Learning

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Abstract

Studies on emotion perception often require stimuli that convey different emotions. These stimuli can serve as a tool to understand how agents react to different circumstances. Although different stimuli have been commonly used to change the emotions of an agent, it is not clear how to measure the emotional state of an agent.

This paper suggests a new method for measuring the emotional state among interacting agents in a given environment. We present the modeling of an adaptive emotional framework that takes into account agent emotion, interaction and learning process. For solving the problem, we employ a non-cooperative game theory approach for representing the interaction between agents and a Reinforcement Learning (RL) process for introducing the stimuli to the environment. We restrict our problem to a class of finite and homogeneous Markov games. The emotional problem is ergodic: each emotion can be represented by a state in a Markov chain which has a probability to be reached. Each emotional strategy of the Markov model is represented as a probability distribution. Then, for measuring the emotional state among agents, we employ the Kullback-Leibler distance between the resulting emotional strategies of the interacting agents. It is a distribution-wise asymmetric measure, then the feelings of one player for another are relative (different). We propose an algorithm for the RL process and for solving the game is proposed a two-step approach. We present an application example related to the selection process of a candidate for a specific position using assessment centers to show the effectiveness of the proposed method by a) measuring the emotional distance among the interacting agents and b) measuring the "emotional closeness degree"of the interacting agents to an ideal proposed candidate agent.

Keywords: Adaptive autonomous agents, emotional model, Kullback-Leibler distance, game theory, reinforcement learning.

1. Highlights

- We suggest a new method for measuring the emotional state among interacting agents
- We employ a non-cooperative game theory approach for represent the interaction
- The Reinforcement Learning process introduces the stimuli to the environment
- For measuring the emotional state it is employed the Kullback-Leibler distance
- We present an application example related to assessment centers

2. Introduction

2.1. Brief review

Emotions are a fundamental aspect of life and are very complicated to be model. Such complexity arises from the fact that they can be affected by many factors (Ding et al., 2012; Vogt & Andre, 2006; Mill et al., 2009). Current discussion in psychology classifies emotions in two different essential categories: the basic or primary and the social emotions. We will focus on the basic set proposed by Ekman et al. (1982) composed by six primary emotions: i) anger, ii) disgust, iii) fear, iv) joy, v) sadness, vi) surprise. This set is characterized by the fact that are emotions which we feel instantly as a response to a stimulus.

Many real-world applications depend on knowing human's affective states (emotions). Affective states are complex psycho-physiological constructs composed of three fundamental dimensions: valence, arousal, and motivational intensity. We are interesting in the motivation intensity that refers to the strength of urge to move toward or away from a particular stimulus. For instance, selecting the ideal or expected candidate (Clempner, 2010; Belkaid & Sabouret, 2014) is crucial for organizational success (employment, especially management or military command). Dealing with difficult employees (or clients) is a challenging, important part of a manager's job that can be effective handled employing information about the emotional state of that person. Selection methods that allow firms to identify the right people (from a pool of applicants) are vital

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