

# Rough Set-Based Application to Recognition of Emotionally-Charged Animated Character's Gestures

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**Abstract.** This research study is intended to analyze emotionally-charged animated character's gestures. Animation methods and rules are first shortly reviewed in this paper. Then the experiment layout is presented. For the purpose of the experiment, the keyframe method is used to create animated objects characterized by differentiating emotions. The method comprised the creation of an animation achieved by changing the properties of a temporal structure of an animated sequence. The sequence is then analyzed in terms of identifying the locations and spacing of keyframes, as well as the features that could be related to emotions present in the animation. On the basis of this analysis several parameters contained in feature vectors describing each object emotions at key moments are derived. The labels are assigned to particular sequences by viewers participating in subjective tests. This served as a decision attribute. The rough set system is used to process the data. Rules related to various categories of emotions are derived. They are then compared with the ones used in traditional animation. Also, the most significant parameters are identified. The second part of the experiment is aimed at checking the viewers' ability to discern less dominant emotional charge in gestures. A time-mixing method is proposed and utilized for the generation of new gestures emotionally-charged with differentiated intensity. Viewers' assessment of the animations quality is presented and analyzed. Conclusions and future experiments are shortly outlined.

**Keywords:** animation, rough set analysis, subjective tests, emotion, non-verbal modality.

## 1 Introduction

At the beginning of XX century, simultaneously with the invention of the movie, the animation was born. At the very early stage of animation, to create the animated motion, a small black-and-white picture was drawn on several layers of celluloid. Continuity of motion was achieved by introducing very small changes between each frame (cel), drawn one after one. Later the color drawing on papers and on foils attached to the peg was invented. Therefore it was possible to create frames in varied order – first most important and powerful poses were

designed, then transitional frames were filled in, called also in-betweens [3]. The same approach is utilized in the computer animation systems with keyframes [22]. Both traditional and computer keyframe animation aim at animating a character with a highly human appearance, personality and emotions though using different artistic and technical means [20,22].

Correct utilization of poses and transitions between them can implicate different emotional features of the character's motion. As a result of experience derived from the first years of traditional animation the animation rules were created in 1910 by the animators from the Walt Disney studio. These rules state how to achieve specified features, utilizing posing, keyframes, and phases of motion [20,22]. The know-how of a hand-made animation and the rules are being passed through generations of animators. They have a subjective nature, and were never analyzed by scientific means. That is why the starting point of this study is to analyze animations by means of the classification system based on rough sets which is a very suitable method while dealing with uncertain, subjective data [15,16].

We start our work with these traditional animation rules and our aim is to check whether it is possible to generate adequate rules based on motion parametrization and rough set analysis. Further, this is to see whether it is possible to generate automatically animation sequences with a desired emotional features based on the knowledge base and rules generated by the rough set method, without an animator interference.

Communication between humans extends beyond verbal techniques. Gestures comprising body and head movements, and also postures are often employed to convey information in human-to-human communication. Moreover, in some situations they can deliver or enhance the unspoken or obscured by noise speech message. Perception of gestures is also very rarely misinterpreted. This non-verbal modality is therefore of a great importance [6,9], and can be easily associated with emotions. In the paper of Mehrabian [12], and also Hatice et al. [8] it was stated that 93 percent of human communication is nonverbal and the most expressive way humans display emotions is through facial expressions and body gestures.

Therefore, the scenario for this study is as follows. One can analyze and parameterize features of a hand-made animation and then correlate them with the description of emotions. These data can be utilized for the creation of a knowledge base containing feature vectors derived from the analysis of the animated character's emotions. In that way the animator's tasks would be limited to designing a simple animated sequence, and delivering a description of the desired emotions to the expert system. These data should next be processed in the system, in which the animation parameters are modified, and as a result an emotionally-featured animation is generated. The next phase is the assessment of the conveyed emotion rendered into the animation to confirm its quality. The second part of the experiment, presented in this paper, concerns checking the viewers' ability to discern less dominant emotional charge in the gestures of the character. A time-mixing method is proposed and utilized for the generation