Enhancement in Decision of Zero-Sum Game Using Alpha-Cuts

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Abstract
Decision making plays an important role in human life at any stage. Game theory has an important role in decision issues such as economy and management. For being successful in game completely depends on the strategies taken by the player. Strategy depends on the information in hands of player by the past experience. In this article gaming decision making will be enhanced by fuzzy alpha cut set. In order to increase research, the data set is about the position of the opponent in the previous phase and step will be taken by the system automatically in next phase of the game with human interaction. In this article we use fuzzy alpha cut set method for ranking fuzzy numbers. They are not able to determine the risk amount which actually decision maker has in their mind and involve their opinions about the risk with more flexibility and ease in the decision making. Moreover we obtain an efficient degree of security with a certain amount of risk taken.

Keywords
Zero-Sum Gaming, FCL, NPC, Fuzzy Alpha Set, Fuzzy Logic Game

I. Introduction

Game theory is used for modeling in some real cases where there are real situations and conditions. The exact amount of the profit shall be determined but it is not possible and we just estimate the fuzzy values. It is a study of general principles which explains how people and organization act in strategic situations. This theory tries to model the mathematical behavior that governs at strategic situation. This situation of creates depends on the strategies of successful player that are chosen by opponent. The final goal in this knowledge is finding an optimum strategy.

Game artificial intelligence is the branch of videogame development that is concerned with empowering games with the illusion of intelligence. Game AI borrows many techniques from the broader field of AI, from simple finite state machine to state-of-the-art evolutionary algorithms. Among these techniques, fuzzy logic is one of the tools that must be present in the good videogame AI developer. To game Ai pertain many different aspect of a game: animation control, path finding, planning, automatic steps, tactical and strategic thinking, and learning. All these aspects share the same basis; they posed problem whose efficient solution requires Al algorithms. The purpose of game AI is to bring life to the Non-Playable Characters (NPCs) present in the game.

Academic AI is always suffered from a difficulty to define artificial intelligence itself, although it can be typically identified in the study and recreation of human-like or human level cognitive processes and in the capability of these processes to learn. Game AI adds another piece to the puzzle of defining AI. As of now, it is not concerned with the actual existence of intelligence, but just with illusion of it. For a game to be successful, we do not really need highly – intelligent, human like, possibly unbeatable expert opponent, what is requires is a compelling adversary, an AI agent that is fun to play against and that is an at least not obviously stupid.

Fuzzy Logic

Fuzzy logic is a superset of conventional logic that has been extended to handle the concept of partial – truth values between the Boolean dichotomy of true and false. Fuzzy logic usually takes the form of a fuzzy reasoning system and its components are fuzzy variables, fuzzy rules and a fuzzy inference engine. Using fuzzy set theory, variables are fuzzy by selecting a set of membership function on their possible range of values. The membership functions map the crisp value of a variable to a linguistic label with a degree of truth, usually in the range [0, 1]. For example, the range of speed of a vehicle 0 -120 mph.

Fast={81,82……120}
Medium={41,42....80}
Slow = {0, 1, 2, …, 40}

Fig. 1: Example of Crisp Set

Fuzzy rules can be creates using the defined fuzzy variables and their sets. Those rules are usually in the form if-then with a grammar similar to Boolean logic. Rules determine the values of output variables given the current values of input variables. Operators such as AND, OR and Not are also given a meaning in fuzzy logic. Once the rules have been created, a fuzzy inference engines is used to infer conclusion from the current values of the variables and the rules that govern the system. Output variable are thus given a fuzzy value. Eventually, a De-fuzzification can be performed to transforming the output of the fuzzy engine into a crisp value.

Nowadays, many controllers use fuzzy logic, from dishwasher to electrical switches to hovering helicopters. Fuzzy logic is used with great success in control system field due to its similarity to human reasoning, allowing experts of the field, not necessarily programmers, to take part in the design process. Fuzzy logic is also used in conjunction with other AI techniques, such as evolutionary algorithms or neural networks, in learning and classification. Fuzzy

logic has been tested in games pursuing the quest for simple design couples with intelligent agent.

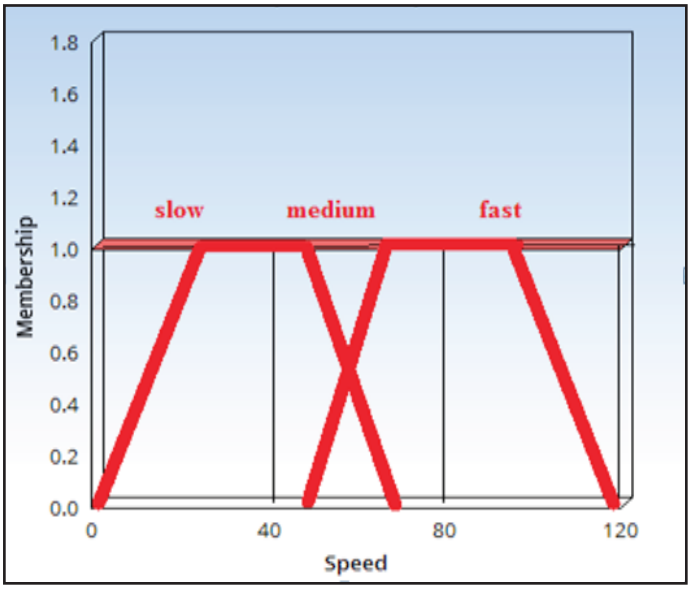

Fig. 2: Example of Fuzzy Set

Alpha-cuts – Alpha-cut of a fuzzy set is the crisp set use to improve decision making process. It represents both, a fuzzy set and its associated membership function. If x is the parameter function can be written as A(x). An alpha-cut of the membership function A (denoted α A) is the set of all x such that A(x) is greater than or equal to alpha (α). A strong alpha - cut (denoted α +A) is the set of all x such that A(x) is strictly greater than alpha (α).

That is the alpha-cut of a fuzzy set A is the crisp set α A that contains all elements of the universal set X. whose membership grades in A are greater than or equal to the specified value of alpha.

$$A\alpha = \{x \in X \mid A(x) \geq \alpha, \alpha \in [0, 1]\}$$

Fuzzy set is use for determine α value using different functions like mean, centroid, variance. After find α-value we will cluster all the values in fuzzy sets. De-fuzzification will do with Min-Max algorithm. The player will use α values as a threshold value. Player will take higher or lower values for decision.

II. Model and Basic Concept

A. α Cuts use in Fuzzy sets

α Cuts is use to improve decision making process. Fuzzy set is use for determine α value using different functions like mean, Centroid, variance. After find α-value we will cluster the all α value in Fuzzy sets. The player will use α value as a threshold value. Player will take higher or lower values for decision. Alpha value gets change in collision in tolerance region.

$$\alpha` = ((\,|\,x2-x1\,|\,+\,|\,y2-y1\,|\,)/2)*\text{depletion})/100+\alpha$$

B. Knowledge Base

Knowledge bases are use to store up the rules and information for future process. Explanation Based learning used a demonstration of knowledge primarily based on the predicate logics. Aim is to expand these methods of learning to system using fuzzy logics. This is useless to have steady knowledge in sequence to learn tactical knowledge, but this turn into essential when learning tactical knowledge which is fuzzy by personality. Representing measured knowledge is become necessary on a tactical point of view. Fuzzy logic use in Chess for made. In this function is to create large fuzzy knowledge bases of rule without human intervention.

The huge number of probable steps has made it practicable to forecast in.

An extended term the consequences of the step played. The definitive objective of a player is to make live the further stone on the board. In the center of game, the majority of the group of stone is in an uncertain state, and the growth of this state cannot be accurately foreseen. It is significant in such a case to have a fuzzy assessment of their states and of the progress of this state when playing dissimilar move.

C. De-Fuzzification

Next when knowledge base get ready slowly while the game is in progress then the De-fuzzification process become stronger in decision making. In this process the alpha set first applied for De-fuzzification process and calculated for a single value which improves decision. Usually a value if reached less than 0.5 then we do not perform activity and wait for another movement and otherwise take decision to create a move in the game.

III. Material and Methods

In this rest of paper we will consider the example of the battle city game.

Decision Making plays an important role in human life. In real life usually decisions are formulated under consideration of some questions in mind like what to do, how to do, necessities and un-necessities. The decision of when to fire and where to fire is completely depend on the intelligence of the player. Then the position of the Explosion of enemy will save in the list in form of X and Y axis. The Analyzer will analyze the movement of player and the explosion of enemy or player simultaneously. The Player formulates his decision using uncertain information in hand. Humans use fuzzy numbers to determine the profit rate because of uncertainty in real cases.

Table 1. Reading of Battle City

Rule id	Rule	POS X	POS Y	TANK
1	EXPLOSION	335	120	ENEMY
2	EXPLOSION	10	70	ENEMY
3	EXPLOSION	220	10	ENEMY
4	EXPLOSION	224	10	ENEMY
5	EXPLOSION	340	60	ENEMY
6	EXPLOSION	10	80	ENEMY
7	EXPLOSION	10	80	ENEMY
8	EXPLOSION	10	70	ENEMY
9	EXPLOSION	90	120	ENEMY

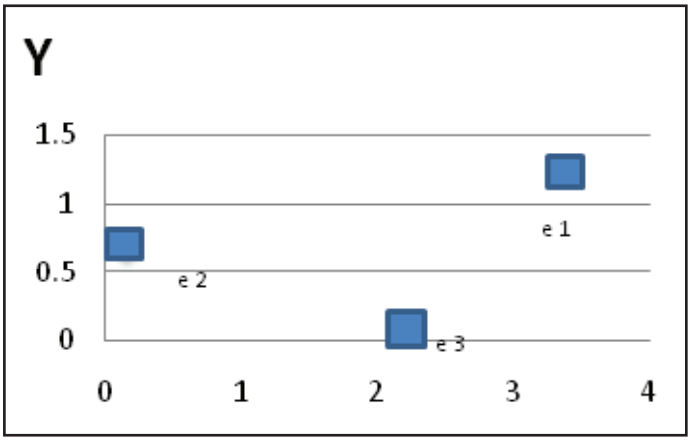

Fig. 3: Explosion in Round -1 (Battle City)

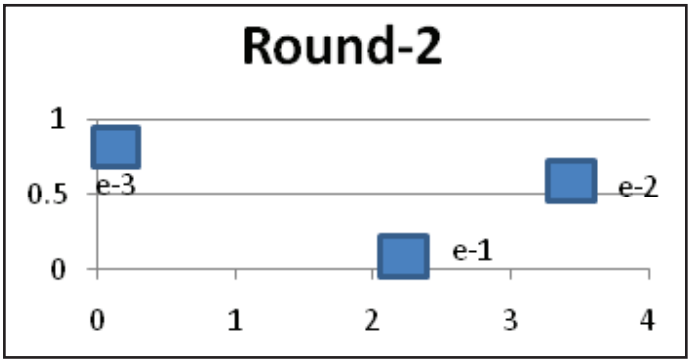

Fig. 4: Explosion in Round -2 (Battle City)

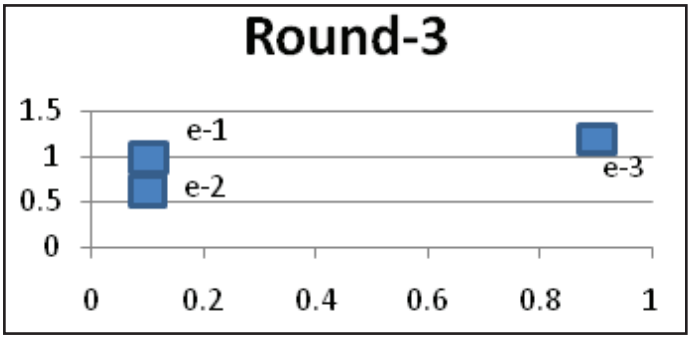

Fig. 5: Explosion in Round -3 (Battle City)

In this paper, we have worked on decision making of the system. For generate the decision by the player tank we use α-cut and rule based method. Alpha-cut of fuzzy sets are the crisp set. Use to progress decision making of the system. An alpha-cut of the membership function A (denoted α A) is the set of all x such that A(x) is greater than or equal to alpha (α). A strong alpha - cuts (denoted α +A) are the sets of all x such that A(x) is exactingly greater than alpha (α) values. Here A represents fuzzy sets (rule). X is the parameter function can be written as A(x). Alpha-cuts of a fuzzy set A are the crisp sets. Whose membership grade in A are greater than or equal to specified value of alpha (α).

Here A represent the fuzzy rules generated in the system. Alpha value is 0.5 that we have considered in this work. Then calculate the membership value of all fuzzy rules. Consider only those whose membership value is less than or equal to 0.5. The rules contain the position of the explosion of enemy in X and Y axis. Those rules will be taken as knowledge base. This knowledge base will be use in the next steps which player will take. In this tolerance value is 10 at both sides of explosion point.

If the explosion of the enemy is done at position (335, 120), Firstly calculate the alpha value of this rule by random function. If the value of this rule is less than or equal to 0.5 then take this rule into consideration. Now if player will be in region x=325-345 and y=110-130 then player will automatically fire. Tank will be intelligent enough to take decision in next step. Tank will know the region where the opponent could be appearing.

A. Tolerance Region (t)

Tolerance interval is a statistical interval within which the confidence level a specific the proportion of attack will be possible. In this we have taken default value is 20. The level of confidence is (1-α). An upper tolerance limit (TL) is simply a 1-α upper confidence limit for 100 percentile of the Area of field.

B. Values of Alpha-cuts and Tolerance Region

Alpha cut value is fix value. In this example we have taken that value 0.5. It could be change according to explosion of tank. If one explosion will be at position (x-95, y-95) then its tolerance region (patch t) will be:

t= α*d, t=0.5*20
t= x: 85.0-105.0, y: 85.0-105.0

Note: If one explosion will be at position (x-95, y-95) then its tolerance region (patch t) will be (t: x= 85.0-105.0, y= 85.0-105.0) and second explosion will be at position (x: 90, y: 90) it exist in tolerance region of first explosion. So collision of second explosion will be there. In this case value of alpha cut will get change:

$$\alpha` = ((\left|x2-x1\right| + \left|y2-y1\right|)/2)*\text{depletion})/100+\alpha$$
$$\alpha` = ((\left|90-95\right| + \left|90-95\right|)/2)*10)/100+.5$$

Note: α <=1, Fuzzy values is between truth value 0 or 1. If value of α>1 then set value of α =1.

t= α`*d
t=1*20
t=x: 70.0-110.0, y: 70.0-110.0

Tolerance Region is get increase. The region between x: 70-115, y: 70-115 is sensitive region for player. The possibility of enemy is high in that region. Player fire in that region automatically.

Table 2. Reading of Battle City with Alpha Cuts

Rule id	Rule	POS X	POS Y	ALPHA	PATCH	TANK
1	EXPLOSION	295	120	0.5	X:285.0-305.0 I Y:110.0-130.0	ENEMY
2	EXPLOSION	290	10	0.5	X:280.0-300.0 I Y:0.0-20.0	ENEMY
3	EXPLOSION	10	20	0.5	X:0.0-20.0 I Y:10.0-30.0	ENEMY
4	EXPLOSION	340	4	0.5	X:330.0-350.0 I Y:0.0-14.0	ENEMY
5	EXPLOSION	340	4	0.5	X:285.0-305.0 I Y:0.0-14.0	ENEMY
6	EXPLOSION	144	10	0.5	X:134.0-154.0 I Y:0.0-20.0	ENEMY

7	EXPLOSION	140	120	0.5	X:130.0-150.0 I Y:110.0-130.0	ENEMY
8	EXPLOSION	10	50	0.5	X:0.0-20.0 I Y:40.0-60.0	ENEMY
9	EXPLOSION	10	60	0.75	X:5.0-25.0 I Y:45.0-75.0	ENEMY

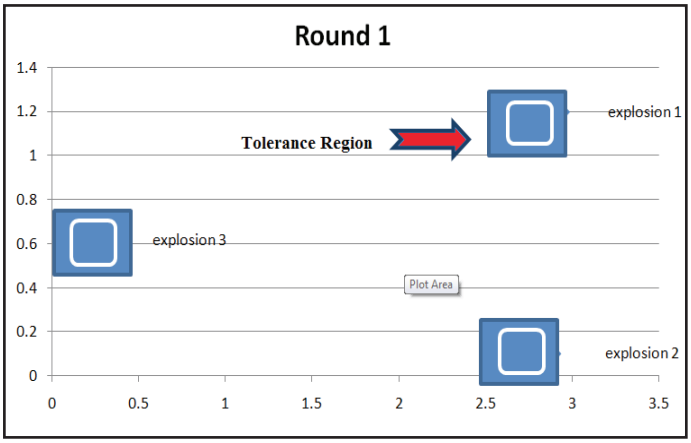

Fig. 6: Explosion in Round -1 (Battle City with α-cuts)

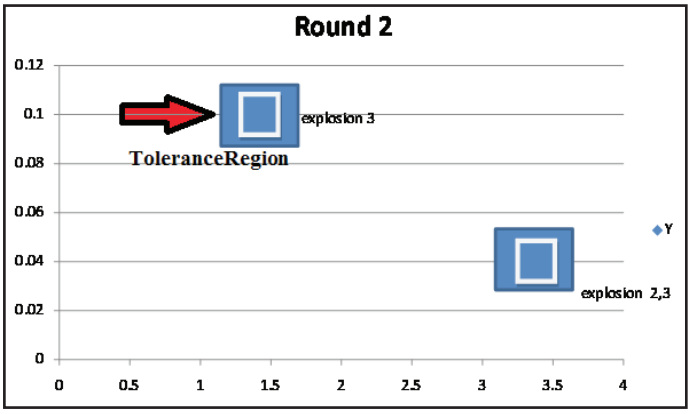

Fig. 7: Explosion in Round -1 (Battle City with α-cuts)

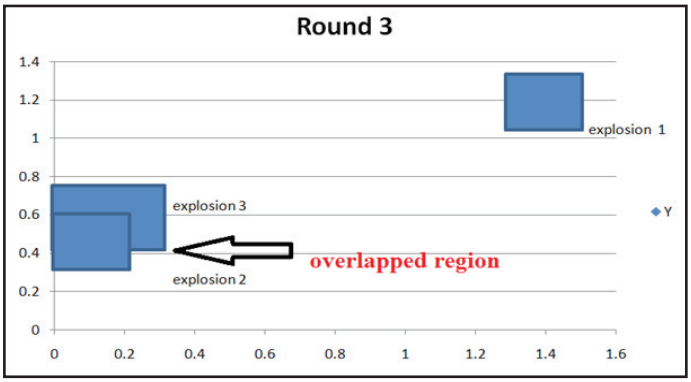

Fig. 8: Explosion in Round -1 (Battle City with α-cuts)

IV. Conclusion and Future Scope

In this work we present a new strategy to enhance the decision making of the zero-sum game with the help of alpha-cuts. We generalized Battle City game with selecting the rules on the bases of randomized value of alpha. By addition of rules the system will able to remember the position of opponent. Attack automatically on that position where opponent appeared previously. We have accomplished the determination of risk amount, which the decision makers have in mind. We could involve the rules in the rule base according higher possibility region of attack.

Moreover we could predicate an efficient degree of security with use of knowledge base. Player could control risk amount which he could face in future. Probability region of opponent could be analyzed on bases of rule List generated through alpha-cut (α- cuts). Predicate logic could be derived from an informal, more intuitive development. Probability region of the Opponent predicate used in well-formed-formula.

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