Modeling Urban Development by Combining Bee Colony Algorithm

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Abstract

During recent decade fast development of cities in developing countries has been converted to considerable problem. Thereby, permanent revising of dynamic urban process with regarding to development in the past and predicting it in future is inevitable. Target of this research is modeling urbanization development of Amol by Bee colony in 28 years between 1988- 2016. For this purpose, initially should gather needed criterions from organizations, analyzed them and extracted user plans which are from Landsite with 92 percent Kappa coefficient by oriented-object method; then verification of plans and revelation of changes have been done which had the most increasing of area in instructed regions 850 hectares and the most decreasing of area 720 hectares. Based on these changes, 11 independent variables have chosen as entrance of model and then potential using of converting and predicting for future modeling by Bee algorithm method. Comparison prediction results with the newest land data and past studying shows that existence research results are more similar to land realities. Also predicted plan has shown the most amount of development in the future is in north-west and west of Amol.

Keywords: Bee colony; oriented-object; urbanization; predicted plan;

Introduction

Universe that we live there is changing and converting subsequently. Totally, can divide effective factors of changing earth to two types include natural and man-made. These factors in different places and conditions have different kind of influences. Permanent development at the first of 1970s has been used for environment and development. Permanent development is instructive element for making nonrenewable sources. Cities in developing countries encounter with hard responsibility because should provide job, insurance and housing for growing population. Urbanization is phenomenon which is ensued from population growth and immigration. Meanwhile modeling urbanization should be done by regarding to parameters and factors of problems, it is combined optimization problem and in this research can achieve to great policy or having effective programming by using geographic information system and remote sensing and combining it with meta- heuristic algorithm(bee colony algorithm).

In this research city of Amol with 304 hectares wide and 740 hectares plain in Mazandaran province is considered and base on developing urbanization problems and environment and also erode urbanization and entice of remaking, developing programs with advanced technology is effective source for is appropriate place for studying.

Research purposes

- Modeling urban development of Amol by using bee colony algorithm
- Identifying index and effective factors of modeling urban development by GIS/RS technics
- Making data bank in identifying factors
- Finding potential places for development in Amol

Hypothesis

Urban development is subordinated by factors such as land use, distance with main roads, distance with business and service centers and factors for modeling urban development.

Geographic information system and remote sensing have ability to solve urban problems.

Research literacy

Urban development is a process based on economy, environment, social, political and population factor which had different stages during the time and can mention to three eras based on urban development of cities (Shokouii, 2014).

Urban development can be defined by coordinate expanding of housing building in a city with needed level and equipped this level to installations, facilities and equipment in standard and acceptable level, on the other hand in urban development should consider to both equality and balance of quality and quantity of which is instruct and number or size of urbanization in these area. Regarding to environment and considering welfare of citizens with following principles of beauty are purposes of city programs (Shokouii, 2014)

Recently quantity methods are essential for classifying and analyzing systematic samples of city growth. So, many of methods are indicated for this course. Some of researchers make difference for shape of cities such as condensation, scattering, dispersion and availability (Glaster et al, 2001). There are eight aspects for growing or shape of cities includes: condensation, conjunction, concentration, centralization, branching, being core, mix using and proximity. They believe that when these samples have low amount and vice versa when these have high amount in a city, this city has sooth growth and physical compression (Ewing et al, 2002).

Growth of city is based on direction and way of expanding and has done as: horizontal growth and vertical growth. Each of these two methods have different and separate from another, physical growth as increasing city boundary or horizontal growth and vertical growth as shedding population and pressed growth of urbanization is indicated. These different samples have consequences and results as their type of growth (Rahnama et al., 2008).

Single-user condensation or population condense is number of housing departments in an area. Totally, low amount of population is population under 25 people per hectare which is almost in North America, Australia and New Zealand. Also many of European countries which have 50 people per hectare and Asian cities with less than 100 people condensation in city (Elkin et al, 1991) or the word with the meaning of unnecessary consumption of earth, monotonous development and uninterrupted, unconventional mutation development and inefficient use of the earth (Peiser, 2006).

Science of remote sensing is converting to one of the fundamental and catholic tools for managing natural source, researchers of governmental organization and security organizations (Kennedy et al, 2009). Satellites of remote sensing are the most common source for diagnosis, quantifying and planning of using field changes because of achieving data alternatively, proportion digital format for computer process (Bad El-Kawy et al, 2011); detection of changing in remote sensing includes two aerial photos or satellite photo from an area in different dates which describes changing by using characters of field (Wang & Xu, 2009).

There are many efforts for precise definition of compressed city. Burton defines it as a city that its condensation is high and has combined using and also has proportion transportation system with condensation which is encouraging social contacts (Burton, 2000). Compressed city by definition of Elkin should have appropriate form and scale which be proportion for pedestrianism, cycling and transportation with condensation which helps to make proportion contacts (Elkin et al, 2000). As another definition, in the form of compressed city, emphasis is on growing metropolitan centers and recycled field and avoiding from expanding and distributing margins (Husseinian, 2006). For instance British government suggests that 50 to 60 percent of future development should be in existence places. More compressed cities from condensing existence cities and encouraging people for live in cities and using of more compressed buildings are available (Williams et al, 1996).

Luis Mumford also mentioned to six levels for growing cities:

Etopolis: in this stage city works as a union and economy of city is based on agriculture.

Polis: in this stage city is as small union which is self-reliance and has business, trade industrial and etcetera activities.

Metropolis: in this stage city achieve to ultimate growth of itself and has large amount of population and high amount of power; also city has some facilities such as water, sewage, electricity, transportation system, trade, industry and etcetera.

Megalopolis: it is a city with hyper growth because of cumulative development of industry, height buildings, multi-way roads, residential complex and condensed transportation network in all parts of city which pull them to destroying.

Tyrannapolis: In these kinds of cities there are more destruction in all fields of trade, business, military and etcetera.

Necropolis: this city is in the worst stage of its growth and it is not appropriate for habitation; thereby can named it bunk city which has different types of illnesses, famine, economic bankruptcy etc.

Long et al in 2009 by studying existence images of Pecan until 1986 could simulate it for 2020 by automatic cells, and make 2020 results as basic for simulation of Pecan for 2049.

Bibber et al (2013) have worked on analyzing Hydra bid cities by Landsite data GIS and ETM/TM. Research has done by TM in three different times. These researches have done in 1989-2000, 2000-2005, and 2005-2011.

Methodology

Amol is in Mazandaran plain and has Haraz River with 76 meter height in 52 degree and 21 minute from the east, 26 degree and 25 minute from north and 70 kilometer far from west to Sari capital of province, 18 kilometers south of Caspian sea, 6 kilometers to north of Alborz domain and 18 kilometers to north east of Tehran. This city from the north to Mahmud Abad, from north east to Babolsar, from east to Babul, from west to Nur and from the south receives to Tehran.

Data which are used in this research include:

- Land sat 5 and 8 images
- Digital Elevation Model (DEM)
- Topography plan 1.2000000 restricted area
- Geology plan of Amol 1.100000

By using these data used layer in this research which include dependence and in dependence variables of this research are extracted. Images of Land sat5 are for 1st of July in 1988 and
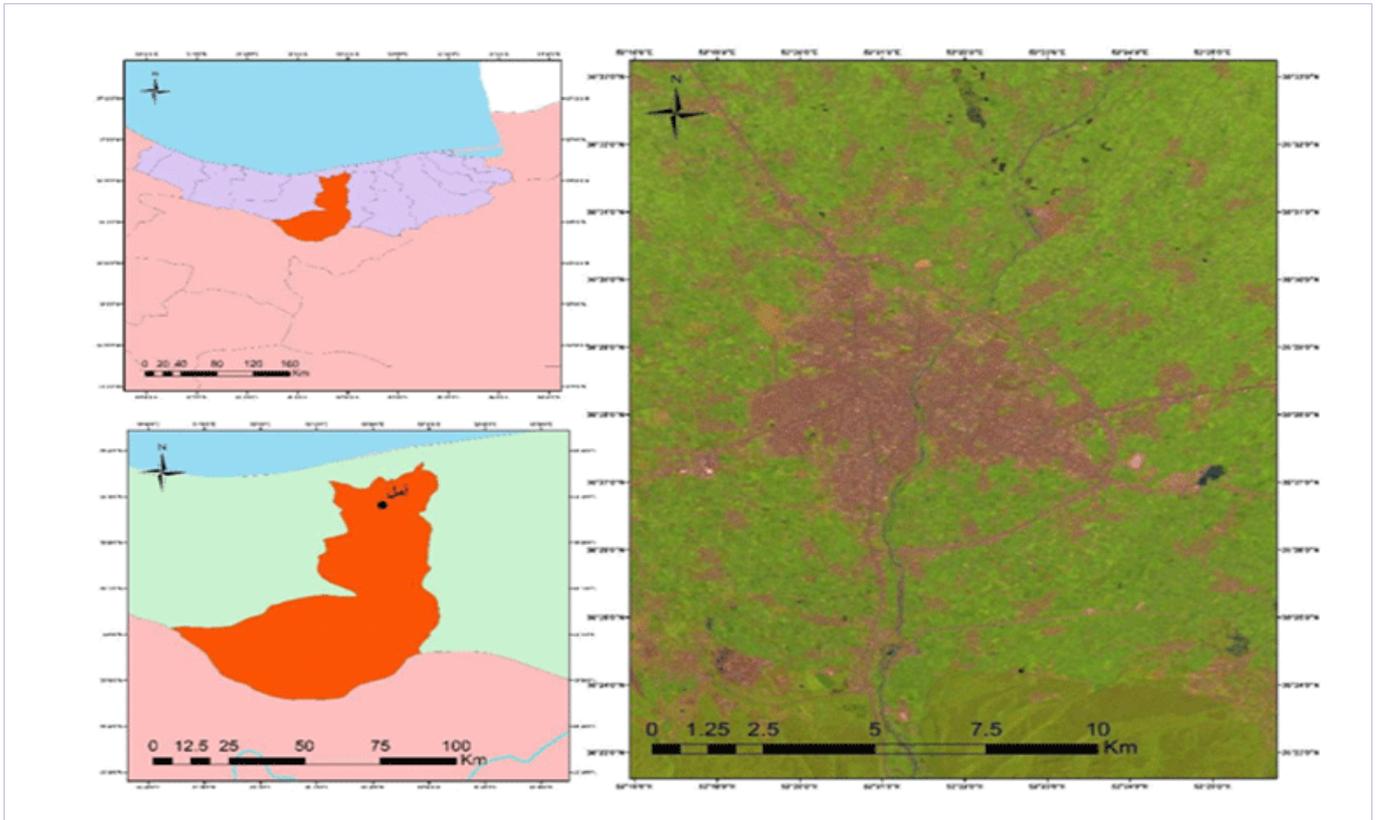
Figure 1: political- official position of Amol in Mazandaran

images of Land sat 8 are for 16th of August in 2016 which give us dependence variable.

Figure 2: Digital elevation model of Amol

Digital elevation model: digital elevation model which is used in this research related to Aster Measured that downloaded from geology site of America and photo below shows this model in 33-255 height.

Topography plan of 1.2000000: it is one of the One of the most widely used maps in this research. In these maps can produce energy transition lines which are as independence variables.
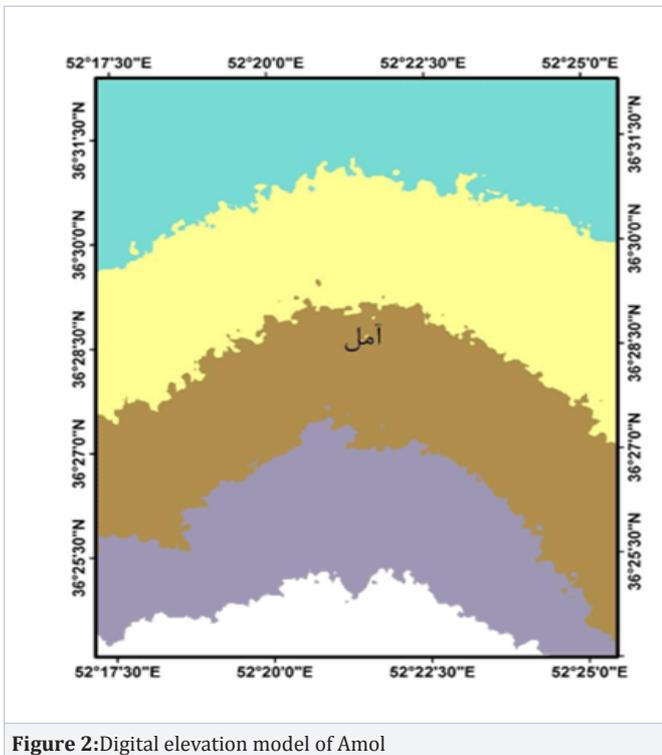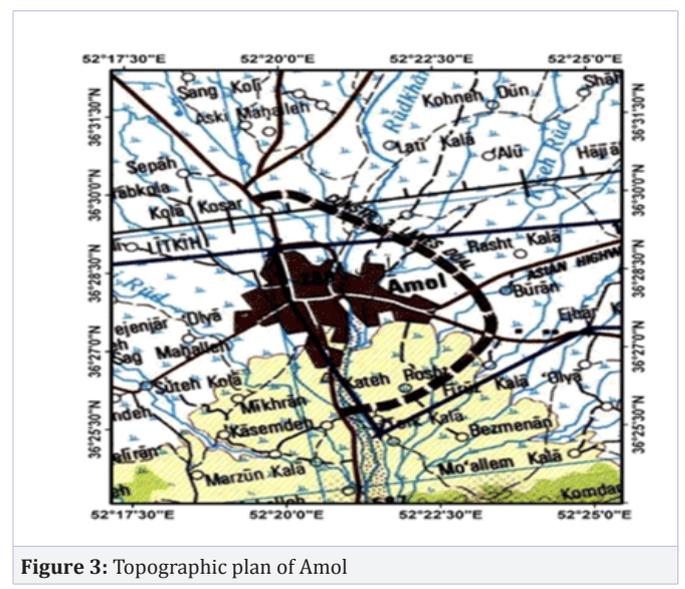

Figure 3: Topographic plan of Amol

Geology plan of Amol 1.100000: It is another widely used map in this research; this map has downloaded from geology site of country in scale of 1.100000. In these maps fault lines which is independence variable is indicated.

Bee colony Algorithm

Bee colony can distribute either in long distance and different directions so that can have nutrition sources. Floral parts with lots of nectar and pollen which can be collected by less amount of attempt are revised by many bees; as some slices of earth which has less pollen and nectars have interested less number of bees. Food seeks process for a colony started by guy's bees (Karoobaga, 2010). Guinea fowlers move into other bulbs in the form of a kettle of plain. During harvest season, colony by reviving some of colony population as guy bee continues to it does seek. When seeking of plain is finished, each guy bee start dancing on the top of save nectar and pollen. This dance which is known as whirling dance transferred information about direction of plain to hive, quality and distance from plain to other bees. This information send bees to plain and most of follower bees go to plain which is more promising to find nectar and pollen. When all bees go to same plain they randomly and for way of their dance district be scattered to other districts and by this scattering not only get a plain but can find the best flowers in each plain. Bee algorithm investigate each point in parametric space constitute by possible responses as source of food. Simple responses classified and new bees for finding the best degree seek around and algorithm as selection of other plains survey the best points (carbora, 2010).

Analyzing data

Purpose of this research is modeling urban development by bee colony algorithm and all data analyzed by ArcGIS and Mat lab software and bee colony has worked by them so that achieved measures computed until model accuracy could be achieved in district under studying.

For inserting data to Mat lab software, after processing in other software such as ArcGIS and Envy; data convert to format of ASCII which do not change in data value and then in environment of software by using IMPORT data enter to software.

Bee Colony Model

The basis of this approach is zoning based on the use of occurrence data. One of the appropriate statistical models for approaching based on existence data is using model by regression.

In the model of regression based on existence data, the equation for predicting the values of the dependent variable (Xi) is based on one or more independent predicate variables (Y) and (Y), but if dependent amounts always have two conditions(occurrence or non-occurrence) it is obvious that general regression sample is not responsible. In this position possibility of happening model called bee colony algorithm which is indicated below:

$$X_{ij} = X_j^{min} + \text{rand}(0,1)(X_j^{max} - X_j^{min})$$

For achieving optimum coefficient bee algorithm in this research, urban development layer has chosen as response variable (Y) which bees use them as center of nutrition? So that give number one to mass movement occurrence and give zero to non-occurrence of it and other extracted layer(distance from road, incline, using field, height, direction of incline, distance from river, distance from transferred energy) as predictor variable (X). The general formula for this analyzing which is used includes:

$$Chaot_{k+1} = \text{Sin}(\pi\, Chaot_k), \qquad Chaot_k \in (0,1), i = 0,1,\ldots, I$$

$$X_{ij} = X_j^{min} + Chaot_{k,j}(X_j^{max} - X_j^{min})$$

Each relationship has been written and implemented in MATLAB software environment.

$$V_{ij} = X_{ij} + \varphi_{ij}\left(X_{ij} - X_{kj}\right)$$

$$fitness_i = \left\{ \begin{array}{ll} \frac{1}{1+f_i} & if\ f_i \geq 0 \\ 1 + abs(f_i) & if\ f_i < 0 \end{array} \right\} \qquad p_i = \frac{fitness_i}{\sum_{i=1}^{SN} fitness_i}$$

Table 1: coefficient of used layers

variable	coefficient
Digital elevation model	0300.300.0
Transfer energy lines	-0300000000
Distance from road	-0300003030
Distance from river	-0300000.00
Distance from business using	03000.0.0
Distance from service using	-0300000000
incline	0300003000
Direction of incline	0300000000

Statistic of bee Algorithm

In this part of model has investigated existence pixels which are added with value1 in model and non-development model 0 indicated and compare in model. Statistical index which are compared in model are Pseudo and R square.

As amount of Pseudo and R square be equal to one, it is indicated fit perfect of model; and if this amount be equal to one it indicate non-fit perfect of chosen factors with dependence factor. If amount of Pseudo and R square be larger than of 0.2 indicate acceptable amount of fit perfect in model. For accuracy of R model ROC is used which model accuracy for district is 0.93 and is indicated in image below:

The above statistic hypothesis neutral (zero for all coefficient) tested K distribution function with freedom degree of K. K is equal to variables of model. If this statistical above be significant in 95% (Chi Square>14.1) hypothesis H0 is denied.

Based on investigations have happened and plan output which is 3610.26 hectares for having very special condition for urban development of Amol includes 13.65% of total fields of Amol.
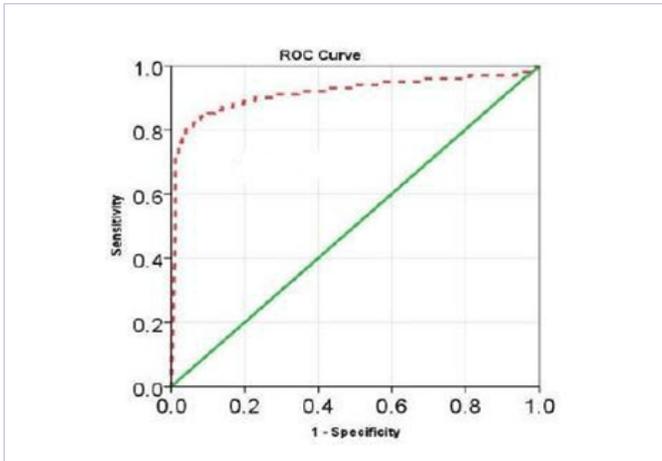
Figure 4: Curve of ROC

Table 2: Statistical index

value	Statistical index
000003.00.	0logL0
0030.3.303	0log(likelihood)
0300.0	Pseudo R_ square
0..3030000	Goodness of Fit
.00.30.30	Chi-square

Figure 5: Development possibility of Amol

Table 3: Possibility of urban development of Amol

Class name	Pixel number	Area per hectare	percent
Too much	45778	3610.26	13.65
much	85220	6720.84	25.41
moderate	111194	8769.27	33.16
less	91795	7239.37	27.37
Too less	1360	107.26	0.41

Base on table and map the most possibility of urban development of Amol is in extension of main streets. Area in north east of city in district of Sheikh Fazollah Nuri has too much possibility for development and approve it in the future can arrive to Mahmud Abad highway.

$$X_{ij} = X_j^{min} + rand(0,1)(X_j^{max} - X_j^{min})$$

Conclusions

Today urban development and modeling of that is one of the most important concerns for city programmers and managers. Bee colony is one of the newest and strongest possible models which can help experts in urban modeling and its output is very practical and have high amount of accuracy rather to other models.

Investigation of hypothesis

There are two hypotheses in this research which is considered below:

- Urban development process are followed by factors such as using fields and distance of them from main roads, services and trade centers and urban development model. This hypothesis by consideration to achieved coefficient conclude distance from service using, business, transferred energy lines and villages which have more coefficient from model to other layers and distance of main lines to other layers are more valuable than other layers.

- Remote sensing and geographic information system have ability to prevent urbanization problems. By regarding to high accuracy of model which has with ROC curve is 93%. Its reason is high accuracy of model in analyzing model which is achieved from satellite images and other available sources. This hypothesis is approved, too.

Suggestions based on research conclusion

- Using satellite maps with high amount of accuracy for urban development area and classifying using fields.
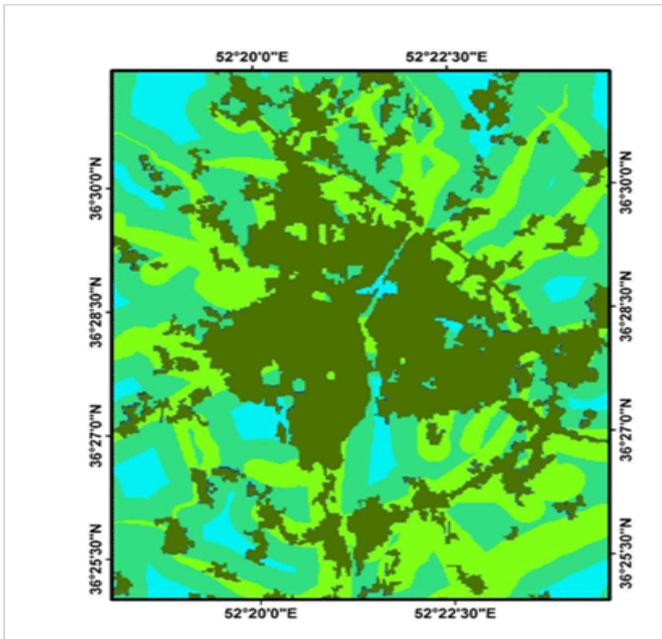
- Using other information layers such as distance from fault and auto cat map of municipality

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