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RESEARCH ARTICLE

SEARCHING MOBILE NODES USING MODIFIED COLUMN MOBILITY MODEL

Parbhakar Singh
Research Scholar, Department of Computer Science,
Singhania University, Pacheri Bari, Jhunjhnu (Rajasthan), INDIA
Email: singhparbhakar87@gmail.com

Dr. Tanweer Alam
Faculty of Computer Science,
College of Computer, Islamic University,
Madinah, SAUDIA ARABIA
Email: tanweerium@gmail.com

Dr. Parveen Kumar
PhD Guide, Singhania University, Pacheri Bari, Jhunjhnu (Rajasthan),
Professor, CSE Department, BIT, Meerut, INDIA
Email: pk223475@gmail.com

ABSTRACT
The Column Mobility Model proves useful for scanning or searching purposes. This model represents a set of Mobile Nodes that move around a given line (or column), which is moving in a forward direction. In this paper we propose a modified column mobility model. A slight modification of the Column Mobility Model allows the individual Mobile Nodes to follow one another and search any node randomly in a column in an efficient manner.

KEYWORDS
Column Mobility Model; Scanning; Mobile Nodes

1. Introduction

The Column Mobility Model proves useful for scanning or searching purposes. This model represents a set of Mobile Nodes that move around a given line (or column), which is moving in a forward direction. A slight modification of the Column Mobility Model allows the individual Mobile Nodes to follow one another.

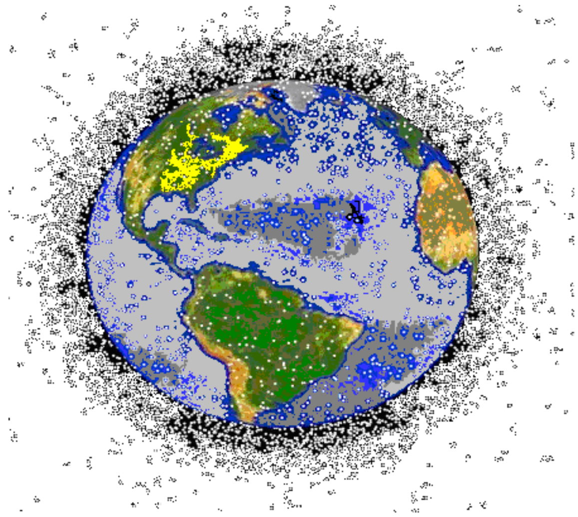

Fig 1: Mobility Patterns: Outer Space

The above figure represents the mobility patterns in outer space.

For the implementation of column mobility model, an initial reference grid is defined. Each Mobile Nodes is then placed in association to its reference point in the reference grid; the Mobile Node is then allowed to move randomly around its reference point. The new reference point for a given Mobile Node is defined as:

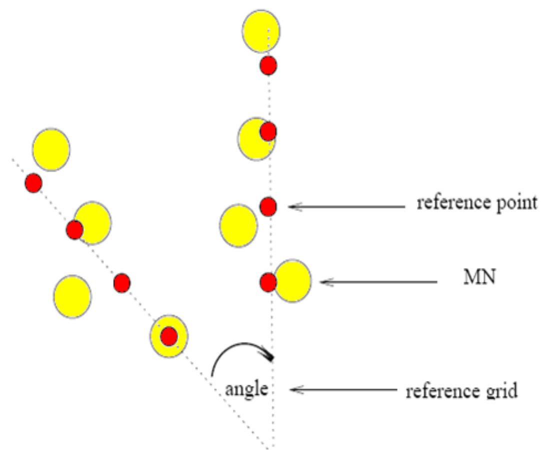

Fig 2. Movements of three Mobile Nodes using the Column Mobility Model

new reference point = old reference point +advance vector

where old reference point is the MN's previous reference point and advance vector is a predefined offset that moves the reference grid. The predefined offset that moves the reference grid is calculated via a random distance and a random angle (since movement is in a forward direction only). Since the same predefined offset is used for all Mobile Nodes, the reference grid is a 1-D line.

Above Figure gives an illustration of four Mobile Nodes moving in the Column Mobility Model. As shown, the Mobile Nodes roam closely around their respective reference points. When the reference grid moves (based on a random distance and a random angle), the Mobile Nodes follow the grid and then continue to roam around their respective reference points.

One group in the figure is using the original Column Mobility Model, where the Mobile Nodes move perpendicular to the direction of movement. The second group is using the modified Column Mobility Model, where the Mobile Nodes move parallel to the direction of movement. We obtained these movement patterns for the Column Mobility Model using a variation of our RPGM model implementation.

2. Modified Column Mobility Model

Modified Column Mobility Model is the most simple group mobility model. It is a conventional model for representing and involving searching activity.

The group consists of Mobile Nodes related with *a line of reference,* which fully characterizes the group behavior.

The movement of individual nodes does not have effect on the location of group center.

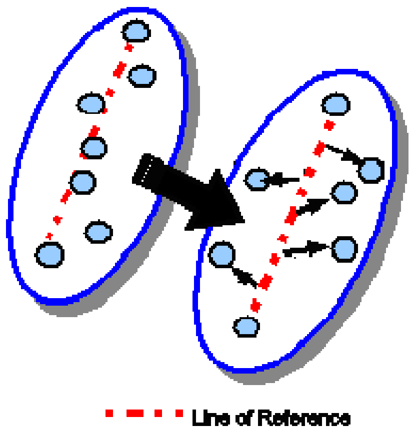

Fig 3: The movement of individual nodes

There are three points.

a) Gravitity Center
b) reference locations
c) target point

The center of gravity is a geometric property of any object. The center of gravity is the average location of the weight of an object. We can completely describe the motion of any object through space in terms of the translation of the center of gravity of the object from one place to another and the rotation of the object about its center of gravity if it is free to rotate.

Click with the mouse to move the column toward this position.

3. Proposed Algorithm

Step1: Move a node in column model
Step2: Get real position
Pos p = (Pos)loc.get(new Integer(node));
Step3: Get theoretic position
Pos r = (Pos)ref.get(new Integer(node));
Step4: Find distance between p and r.
double d=p.distance(r);
Step5: Find the random Location.
int xi=(int)(Math.random()*(d+10));
int yi=(int)(Math.random()*(d+10));
Step6: Check (xi,yi) is upper or lower the diagonal.
If it is upper then incease the value of xi and yi else decrease.
if (p.isLeft(r))
{


```
xi=xi+p.x;
}
 else if (p.isRight(r))
{
 xi=p.x-xi;
}
 if (p.isUpper(r))
{
 yi=yi+p.y;
}
else if (p.isLower(r))
{
 yi=p.y-yi;
}
   return new Pos(xi,yi);
}
```

4. Scanning the Node

The column model tries to represent the moving pattern of a row of robots moving in a certain direction. This behavior can be found on a searching activity (e.g: anti-personal mines deactivation robots).

But the model is not limited to a forward direction normal to the row axis, but any angle could be possible to, for example, forming a "one behind the other" motion, also present in some robotics activities (e.g: transportation convoy).

I think the simpler one is to have a reference initial grid and then allow a node to move around its reference position.

new_reference_pos=old_reference_pos+advance_vector

new_pos = new_reference_pos + random_vector

The Column Mobility Model proves useful for scanning or searching purposes. This model represents a set of Mobile Nodes that have formed a line and are uniformly moving forward in a particular direction. For example, consider a row of soldiers marching together towards their enemy. Each soldier stands next to his/her companions while marching in a uniform manner. A slight modification of the Column Mobility Model allows the individual Mobile Nodes to follow one another. For example, consider a group of young children that walk in a single-file line to and from their classroom.
Sanchez describes a version of the Column Mobility Model in which individual Mobile Nodes are placed in a single-file line and are allowed to move about their initial positions. This process begins by calculating a new_reference_position for an Mobile Node using the equation:

new_reference_position = old_reference_position + advance_vector

where old_reference_position is a static variable indicating the initial location of an MN, advance_vector is a predefined offset, and new_reference_position is the sum of the Mobile Nodes initial location (old_reference_position) and the offset (advance_vector). A second equation is used to calculate the new position of an Mobile Node:

new_position = new_reference_position + random_vector

where random_vector is a random offset and new_position is the sum of the random offset (random_vector) and the current point of reference (new_reference_position).
Consider the example in following Fig.

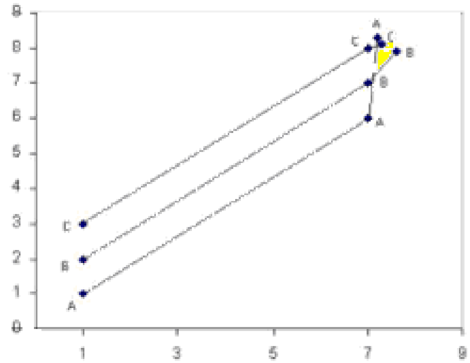

Fig 4: Movements of three Mobile Nodes using the Column Mobility Model

In above Figure, three Mobile Nodes are initially lined up in the lower left-hand corner. The Mobile Nodes begin moving by traveling six units to the right and five units up, as specified by their advance vector: (6,5). In order to determine their final positions, the Mobile Nodes calculate the sum of their new position with a random vector.

In this figure the Mobile Nodes start at the lower left-hand corner of the simulation area and travel towards the upper right hand corner.

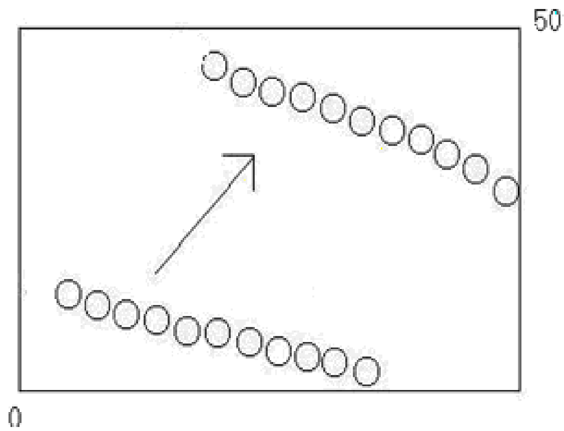

Fig 5: Traveling pattern of 11 Mobile Nodes using the Column Mobility Model

5. Simulation Results

In the performance evaluation of a protocol for an ad hoc network, the protocol should be tested under realistic conditions including, but not limited to, a sensible transmission range, limited buffer space for storage of messages, representative data traffic models, and realistic movement of mobile users.

For the implementation of this model, an initial reference grid (forming a column of mobile nodes) is defined. Each mobile node is then placed in relation to its reference point in reference grid; the mobile node is then allowed to move randomly around its reference point via an entity mobility model. The new reference point for a given mobile node is defined as:

new_reference_point = old_reference_point + advance_vector

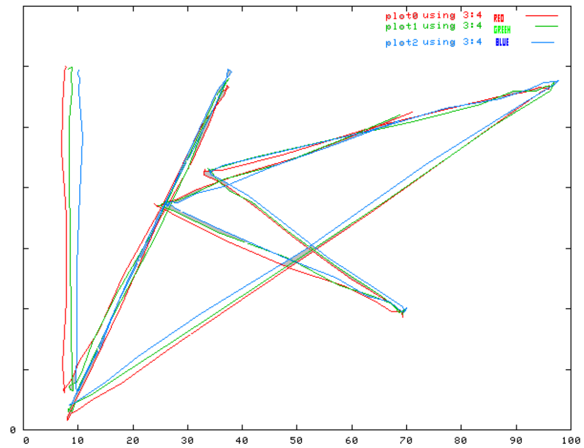

Fig 6: Simulation result

6. Conclusions

In summary, we propose a new methodology which uses force mobility to capture a more realistic depiction of real world interaction between mobile users and directly address some limitations that previous simulations did not. Such limitations are collision avoidance, congestion avoidance, and the overall interaction between Mobile Nodes in a group that is tightly or loosely coupled.

In this paper, we have presented a novel method of generating reproducible and realistic mobility patterns or use in the simulation and evaluation of ad hoc networking protocols. In our individually simulated behavioral model, we simulate the behaviors and movement of individual nodes and their relationship to surrounding nodes in order to generate the overall mobility pattern. We propose this system as a general-purpose framework that may be used to reliably reproduce existing mobility patterns as well as to easily generate useful new ones. In order to validate the model, we have presented statistical characteristics of a few mobility patterns generated by our mobility model. We have shown that different mobility patterns generated in this way stress the Dynamic Source Routing (DSR) protocol in different ways and cause it to perform very differently in each case. We believe that the results shown warrant further investigation into the generation of mobility, as well as communication patterns using this method.

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