Dynamic Tabu Search for Non Stationary Social Network identification based on Graph Coloring

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Outline

Non stationary Social Network

- The Social Networks is a new phenomena that is grown very fast.
- Sometimes is necessary to identificate the users.
- The anthropologists have determined that a social network can be represented as a graph.
  - Weighted Graphs
  - Unweighted Graphs
- Clustering the Social Network using the Graph coloring problem theory.

Non stationary Social Network II

- The Problem of identifiying the users in a Social Network are basically two.
  - How to map tha social network into a graph. The social network can have a lot of features that join users.
  - The social network change along time so we can't use a static identification.

Graph Coloring Problem

- The Graph Coloring Problem (GCP) is a classical NP-hard problem.
- The GCP consist in assigning a color to the vertices of a graph with the limitation that any pair of vertices linked by an edge cannot have the same color.
- There is a large number of algorithm that can solve the GCP:
  - Deterministics:
    - Backtracking
    - DSATUR
  - Stochastics:
    - Simulated Annealing
    - Tabu Search
  - Evulutionary
    - Genetic Algorithms
  - Swarm based algorithms
    - Ant Colony Optimization
    - Particle Swarm Optimization
    - Swaim Intelligence

Dynamic Tabu Search Algorithm

- Model the Social Network into a Graph.
  - Using a threshold to have a unweigthed graph.
- Apply a Graph coloring algorithm for clustering.
  - We use Tabu Search because this algorithm keep a trace of the visited part of the space.
- Adapt the algorithm to the dynamic system

Graph modeling

- Each user is going to be a vertex.
- The relation between users is going to be the edges.
- The rule to assign an edge between two vertices is:

$$if \sum_{F} F(v_a, v_b) > U \text{ then } \exists e(v_a, v_b) \ , \ e \in E, \text{ else } not \exists e(v_a, v_b)$$

- Being F the features that join two vertices and U the threshold to accept or not the relation.
- As we built a Graph of relations, we must transfort the graph into it's complementary.

Tabu Search Algorithm

- The Tabu Search Algoritm consist in a method that keeps a list of previously visited solutions that don't solve the problem.
- The algorithm uses this list to avoid visiting parts of the space where there isn't the solution.
- If we find a solution that is better than the best solution found, then we add it to the Tabu list.
- If we find a solution that is worse then avoid.

Dynamic Algorithm

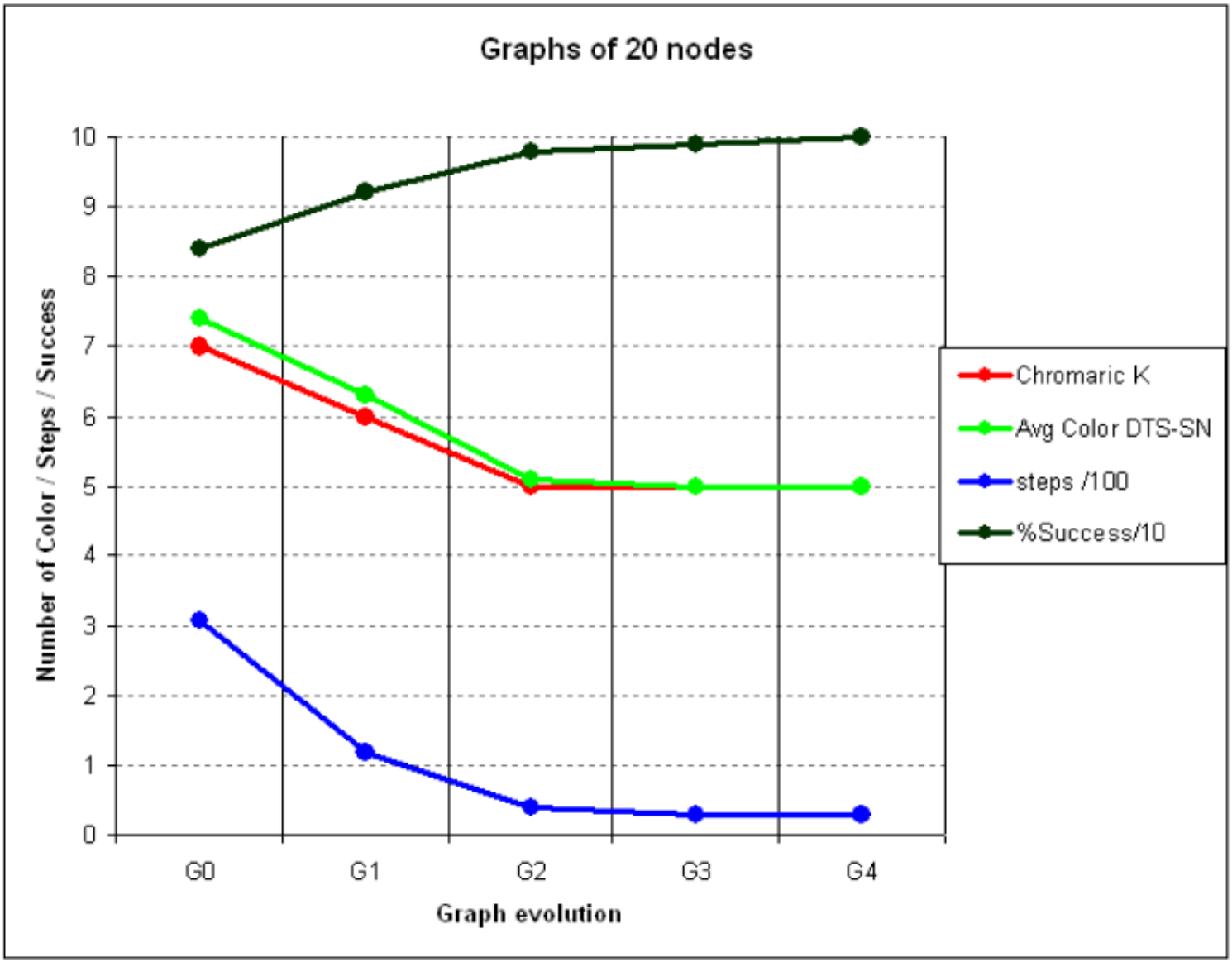
Algorithm 1 Dynamic Tabu Search for Social Networks (DTS-SN)

```
Transform the Social Network into a Graph G
initialize maxiter,maxcolor,mincolor
let C = maxcolor
while C = mincolor and iter < maxiter
    let iter = 0
        while not solved(G) and iter < maxiter
            iter = iter + 1
            assign valid colors to G
            if in TabuList(G) then
                continue
            else
                Add to TabuList
            if G change then
                Change_TabuList()
        end while
    if solved(G) then
        Let C= C-1
end while
```

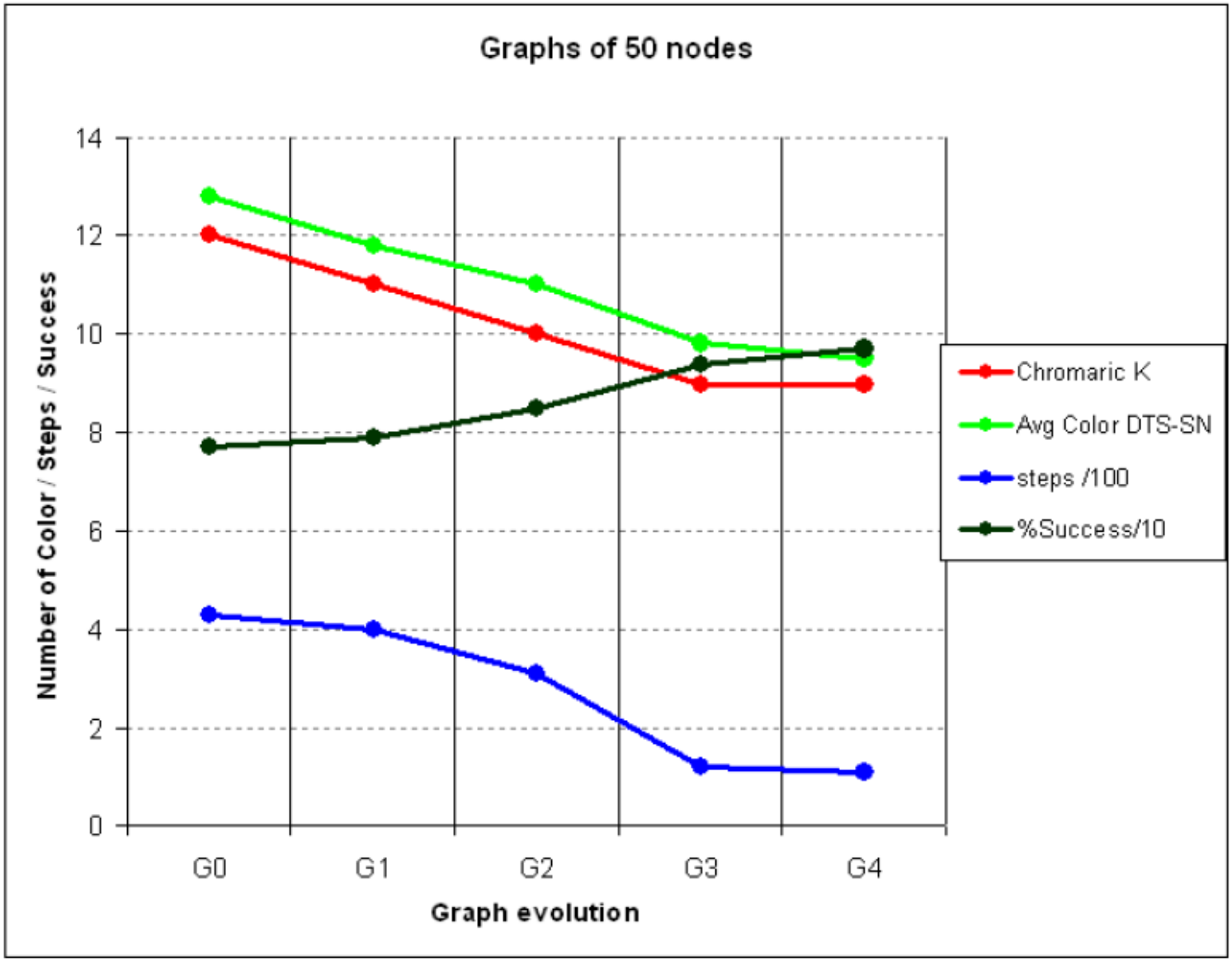
Experimental results.

1. We have simulated diferent social networks with the features:
   1. Studies degree
   2. City
2. We have generate 50 graphs from these social networks using a threshols.
3. We have apply the DTS-SN algorithm to social networks statically.
4. We have modify the social networks dynamically and try to color the resulting graphs.
5. We have apply the DTS-SN algorithm to social networks statically after the modification introduced to them.

Results I


Graphs of 20 nodes
Number of Color / Steps / Success
Graph evolution
G0
G1
G2
G3
G4
0
1
2
3
4
5
6
7
8
9
10
Chromaric K
Avg Color DTS-SN
steps /100
%Success/10

Results II


Graphs of 50 nodes
Number of Color / Steps / Success
14
12
10
8
6
4
2
0
G0
G1
G2
G3
G4
Graph evolution
Chromaric K
Avg Color DTS-SN
steps /100
%Success/10

Conclusions.

- We have proposed a method to transform a Social Network into a Graph.
- This method helped by a threshold allows to built different graphs giving more emphasis to one feature or another.
- We use the GCP to identify the social network using a Tabu Search algorithm.
- We have proof that our DTS-SN can solve the GCP of a graph that change along time.
  - Our algorithm works better than a standard TS algorithm,

Future work.

- We want to test our algorithm over real data sets.
- We want to improve the modeling of the Social Network into a Graph.
- We want to improve our algorithm using hybrid approaches.
- Other methods that keep a trace of the visited space can be tested for coloring dynamically changing graphs.

Questions

Thanks for your attention

Děkuji za pozornost