CHAPTER VII

CONCLUSIONS AND FUTURE SCOPE

Chapter 7

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This thesis demonstrated that how we can obtain good solutions to difficult NP-hard prblems by using new local search algorithms. The thesis mainly focused on four different problems, the weighted/unweighted minimum vertex cover problem, the weighted/unweighted maximum clique problem, matching protein structures in protein alignment problem and minmum connected dominating set problem on ad hoc wireless networks.

The minimum vertex cover problem is a classic problem and is known to be difficult to approximate. In the two versions i.e., decision and optimization version of minimum vertex cover problem, the thesis mainly focused on optimization version of the problem. Two new edge based local search approaches based on the parameter *support* of vertices of a graph, one is slightly differ from the other, applied into the optimization version of the vertex cover and the weighted vertex cover problems. Proposed approach tested on a wide range of test problems from various sources, it includes thousands of random graphs. When creating random graphs for weighted version of the vertex cover problem, weights on the vertices were allocated uniformly in some interval like $[1,\ d(i)^2]$ and $(i\ mod\ m) + 1$ where $1 \leq i \leq n$ and m is a positive integer. When m is chosen a large value, the weighted random graph instances become very harder. The proposed edge based local search approaches applied on these test instances, computational experiments shown that, the proposed approach outperformed recently proposed heuristics and meta-heuristics for this problem. An interesting direction for future research is to find and study other problems where this approach is applicable.

The second problem focused on this thesis is the difficult maximum clique problem and its weighted version. To benchmark the proposed local search approaches described for the vertex cover and the weighted vertex cover, the popularly known benchmark instances of maximum clique problem have been taken. The relation between MVC problem and MC problem similarly MWVC problem and MWC problem were used to benchmark the proposed heuristics. The BHOSLIB and DIMACS benchmark instances of maximum clique problem were tested using the proposed approaches to approximate the problem. The obtained results shown that the proposed approaches outperformed recently developed heuristics in both solution quality and running time of the problem concerned. i.e., the results on the tested benchmark instances entailing that the proposed approaches reached state-of-the art performance on solving the graph optimization problems.

Chapter 5 dealt with the application of proposed approaches in the "real-life" problems. Matching protein structures in protein alignment problem have been taken to evaluate the performance of proposed heuristic in real time environment problems. The proposed approach tested on the instances of matching protein structures of protein alignment problem, they have been taken from the protein data bank. The results in the experiment revealed that the proposed approaches efficiently performed in computing common substructure of proteins. Moreover with this procedure it is possible to reduce the time consumption to find the maximum commmon substructure of two proteins because thhe proposed approach is considerably faster than a widely used algorithm. Its use is likely in protein structural comparison and protein classifications. In future a problem of deciding the secondary structure of protein will also be taken up for analysis, by depicting the topological structure. Appropriate graph theoretic algorithm will be designed to identify other parameters of the structure.

Chapter 6 concerning with a new local search approach for the minimum connected dominating set problem. The proposed heuristic algorithm applied to ad hoc wireless networks, which are modeled as unit disk graphs. The proposed approach efficiently finds the MCDS of a graph with the parameter support of vertices. The model of the proposed heuristic is very simple and also easy to implement. An experimental study has been conducted to study the performance of the proposed algorithm, it shows that the proposed heuristic outperformed compared algorithms from small to large values of r and v. The above mentioned advantages and the simplicity of the proposed heuristics make them an attractive alternative approach for solving the graph optimization problems in dynamic environments.

In concluding remarks, heuristics approaches are very effective for several combinatorial optimization problems, with this view, effective heuristics VSA, SRA and SLS are developed for graph optimization problems. The computational results on the random and DIMACS instances for both weighted and unweighted cases demonstrate that the proposed heuristics were capable of reaching state-of-the art results in the graph optimization problems even in the absence of recently developed meta-heuristic components. VSA, SRA and SLS outperformed the recent heuristics, which are compared, in terms of obtainable solutions for all the graphs. In the high density weighted random graphs and DIMACS weighted instances, the SRA finds reasonable solutions in very short time compared to other heuristics. VSA, SRA and SLS greatly reduces the computational complexity and it can be implemented in time $O(mn)$ where n is the number of vertices and m is the number of edges of the graph. More over percentage of deviation of other heuristics are higher than that the proposed algorithms to reach optimum where we know the optimum solutions. The excellent performance of VSA, SRA and SLS on the benchmark instances reported here suggests that the underlying heuristic method has substantial potential to provide the basis for high-performance algorithm for other combinatorial optimization problems.