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MCTR1005: Optimization Techniques in Mechatronics Systems

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Quiz-1

Report

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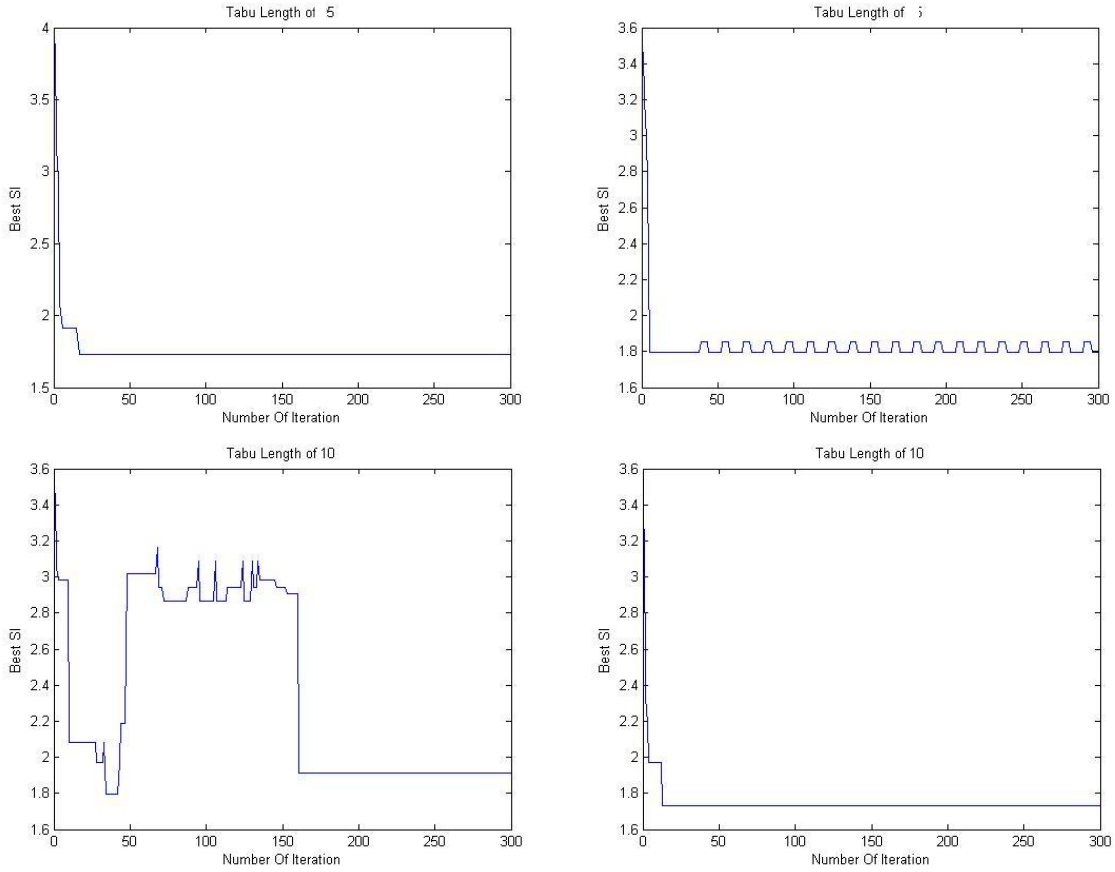
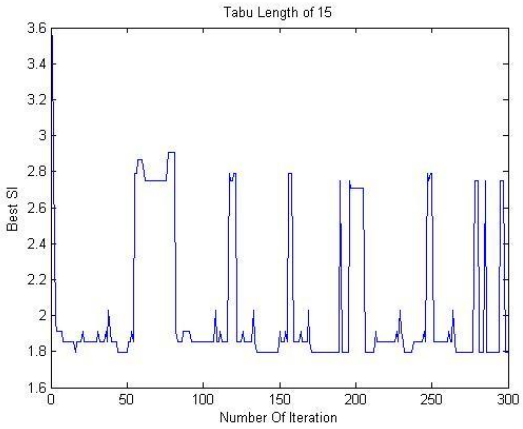
Application number 10-2220

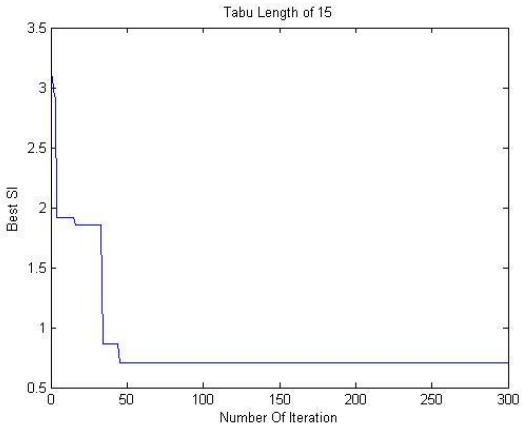
The Tabu search algorithm was used to find the least smoothing index (SI) sequence for the given problem of ALBP. The changes done to the code were as follows:

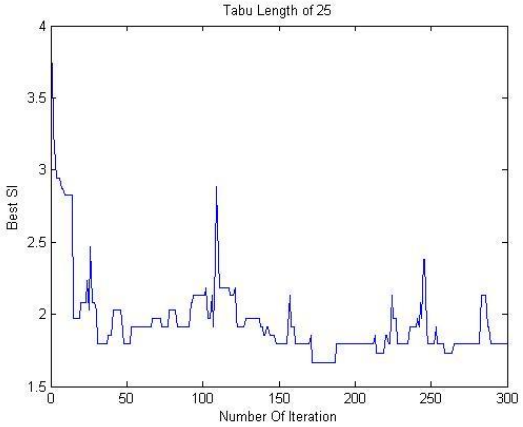
- Changing the m files to functions and changing the global variables to function handles.
- Editing stations.m so that it outputs the sequence with the least SI and its corresponding SI.
- Adding a file called Tabu.m that implements the Tabu search algorithm.

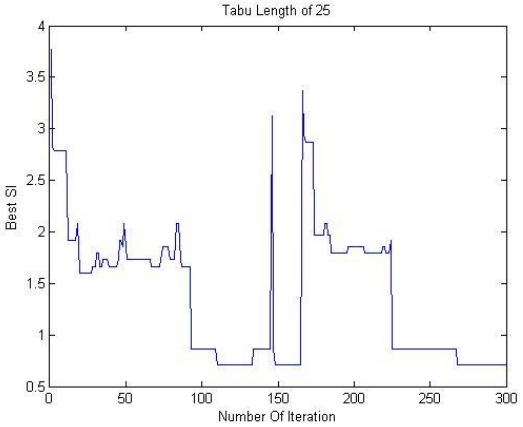
At first the initial sequence was generated randomly using initial_solution.m, large fluctuations in the final value of the SI for different Tabu lengths were observed. The code was run 10 times for each Tabu length and each run with a new random initial solution. The SI was plotted against the number of iteration for two runs is as shown:

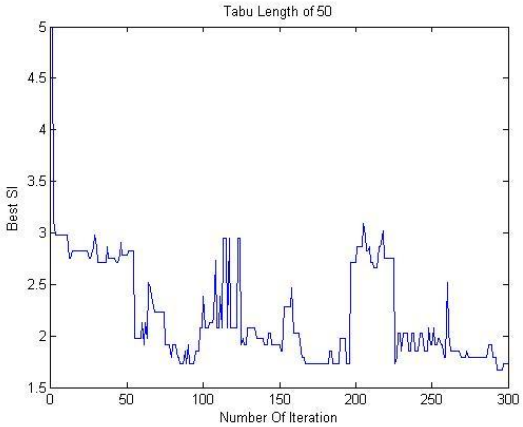


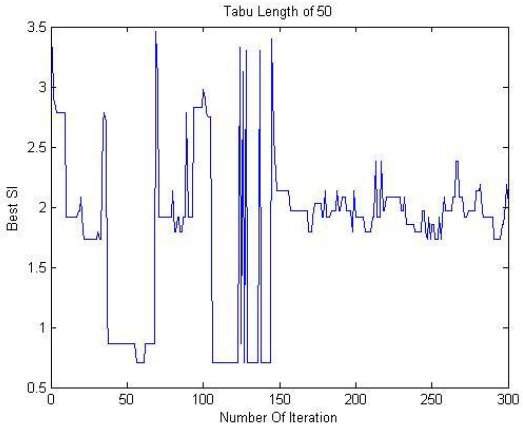

Tabu Length of 15
Best SI
Number Of Iteration


Tabu Length of 15
Best SI
Number Of Iteration


Tabu Length of 25
Best SI
Number Of Iteration


Tabu Length of 25
Best SI
Number Of Iteration


Tabu Length of 50
Best SI
Number Of Iteration

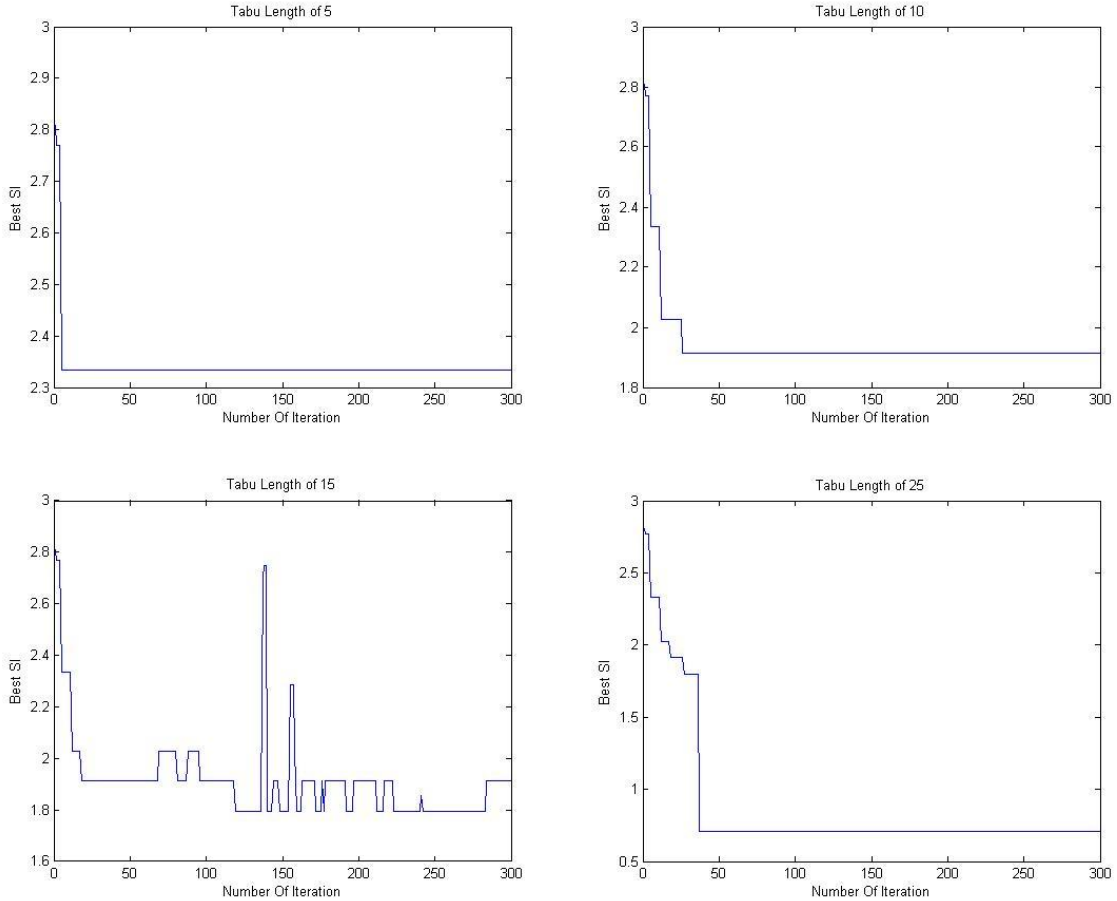

Tabu Length of 50
Best SI
Number Of Iteration

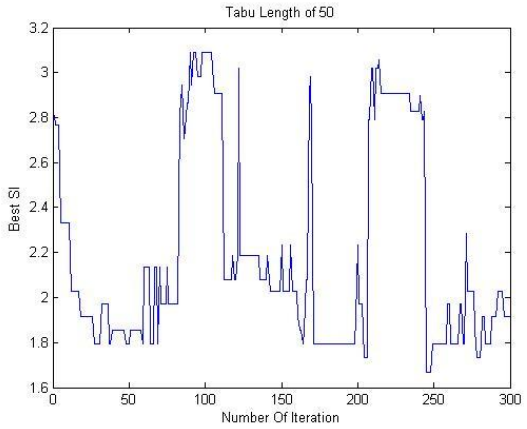
The table below shows the SI acquired from each run for each Tabu length and the average of all the runs.

Tabu Length	Acquired SI after 300 iterations										
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Average
5	1.73	1.73	0.866	1.73	1.79	1.91	1.85	2.75	2.90	1.73	1.90
10	1.91	1.91	1.91	1.85	1.79	1.91	2.98	1.73	1.73	1.79	1.95
15	0.707	0.866	0.707	0.707	1.79	0.707	0.707	0.707	0.707	0.707	0.832
25	0.707	1.79	0.707	0.707	0.707	0.707	1.85	0.707	0.707	2.13	1.07
50	2.03	1.97	0.707	2.91	1.97	2.02	2.89	1.732	1.86	2.79	2.09

It is observed that for a random initial sequence a Tabu length of 15 converges the best and achieves the least SI of 0.832 knowing that the global minimum of this problem has an SI of 0.7071.

The code was then changed fixing the initial sequence to be from 1 to 24 in an ascending order, the runs showed that for each Tabu length the SI converges to a certain value as shown:

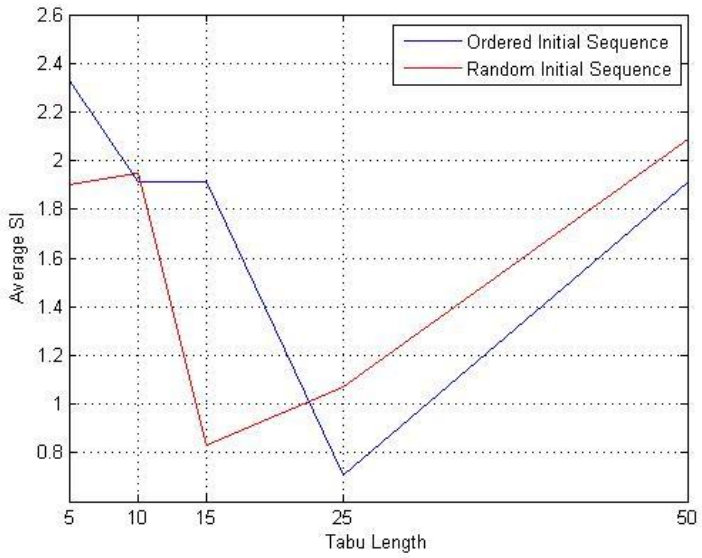




The table below shows the final achieved SI for different Tabu lengths:

Tabu Length	Acquired SI after 300 iterations
5	2.33
10	1.91
15	1.91
25	0.707
50	1.91

The results show that the SI converges to its global minimum at a Tabu length of 25.

Conclusion:

After examining this problem, it was discovered that a Tabu length of 25 has the highest chance to achieve the optimum solution in case of an ordered initial solution. But if the initial solution was randomly generated, a Tabu length of 15 is better achieving an average SI of 0.832 after 300 iterations. The figure below shows the variation of the SI for each Tabu length once for the random initial sequence and once for the ordered initial sequence.