Box 3.3
Parameter Settings for ACO Algorithms with Local Search

The only ACO algorithms that have been applied with local search to the TSP are ACS and $\mathcal{MM}$AS. Good settings, obtained experimentally (see, e.g., Stützle & Hoos [2000] for $\mathcal{MM}$AS and Dorigo & Gambardella [1997b] for ACS), for the parameters common to both algorithms are indicated below.

ACO algorithm	α	β	ρ	m	τ_0
$\mathcal{MM}$AS	1	2	0.2	25	$1/\rho C^{nn}$
ACS	—	2	0.1	10	$1/nC^{nn}$

The remaining parameters are:

$\mathcal{MM}AS$: τ_{max} is set, as in box 3.1, to $\tau_{max} = 1/(\rho C^{bs})$, while $\tau_{min} = 1/(2n)$. For the pheromone deposit, the schedule for the frequency with which the best-so-far pheromone update is applied is

$$f_{bs} = \begin{cases} \infty & \text{if } i \leq 25 \\ 5 & \text{if } 26 \leq i \leq 75 \\ 3 & \text{if } 76 \leq i \leq 125 \\ 2 & \text{if } 126 \leq i \leq 250 \\ 1 & \text{otherwise} \end{cases} \tag{3.20}$$

where f_{bs} is the number of algorithm iterations between two updates performed by the best-so-far ant (in the other iterations it is the iteration-best ant that makes the update) and i is the iteration counter of the algorithm.

ACS: We have $\xi = 0.1$ and $q_0 = 0.98$.

Common to both algorithms is also that after each iteration all the tours constructed by the ants are improved by the local search. Additionally, in $\mathcal{MM}$AS occasional pheromone trail reinitializations are applied. This is done when the average λ-branching factor becomes smaller than 2.00001 and if for more than 250 iterations no improved tour has been found.

Note that on individual instances different settings may result in much better performance.

period of time in which while $\mathcal{MM}$AS with 3-opt is still in the explorative phase, $\mathcal{MM}$AS with 2-opt and $\mathcal{MM}$AS with 2.5-opt are already in the exploitation phase.

In any case, once the final tour quality obtained by the different variants is taken into account, the computational results clearly suggest that the use of more effective local searches improves the solution quality of $\mathcal{MM}$AS.

Number of Ants

In a second series of experiments we investigated the role of the number of ants m on the final performance of $\mathcal{MM}$AS. We ran $\mathcal{MM}$AS using parameter settings of $m \in \{1, 2, 5, 10, 25, 50, 100\}$ leaving all other choices the same. The result was that on small problem instances with up to 500 cities, the number of ants did not matter very