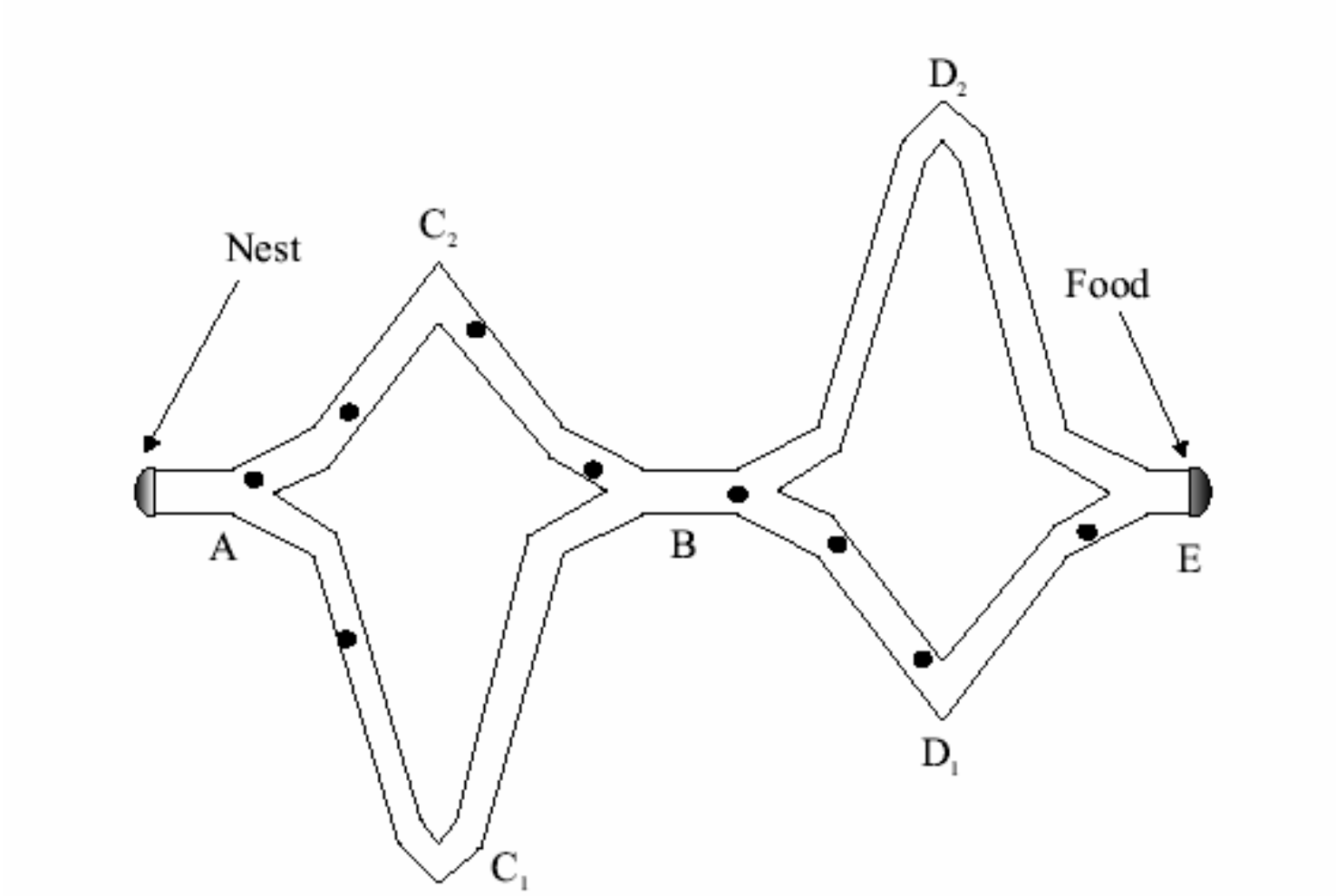
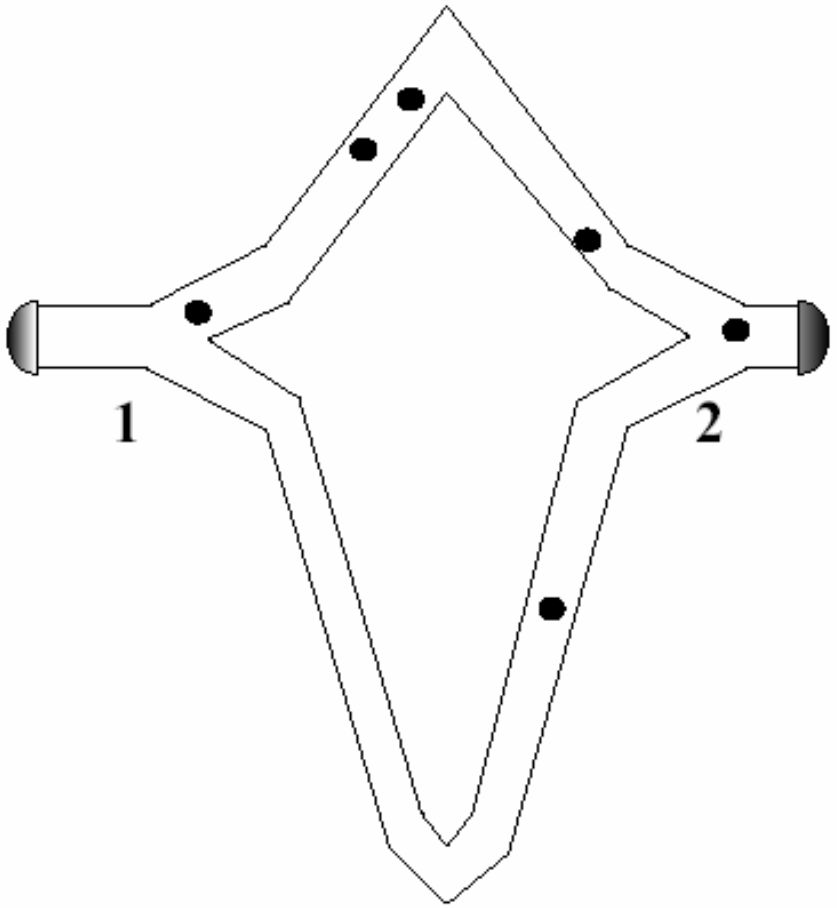
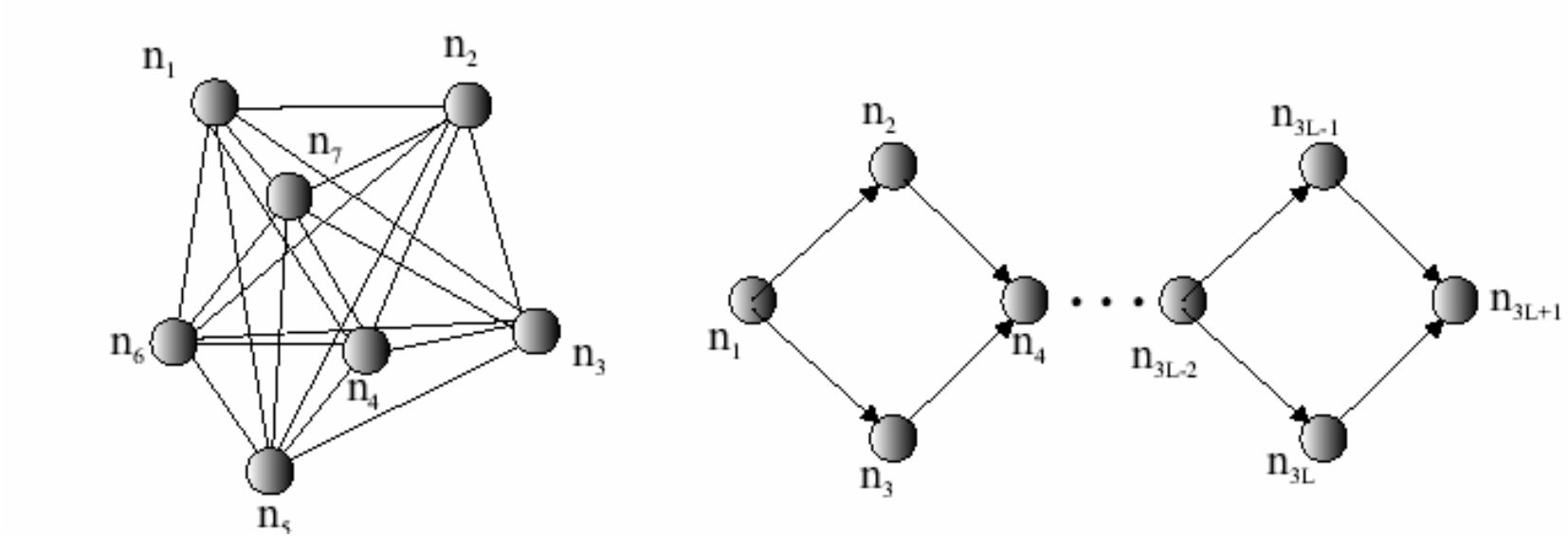


Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde



Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde



Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Applications of PSO

- ***Biomedical applications*** (e.g. gene regulatory network inference, protein structure prediction)
- **Communication networks** (routing etc.)
- **Clustering and classification**
- **Combinatorial optimization** (TSP etc.)
- **Control** (traffic flow, combustion, plane landing etc.)
- **Engine optimization**
- **Games** (agents)
- **Finance** (investment decisions, portfolio selection etc.)
- ***Neural network optimization***

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Applications of PSO (cont'd)

- **Robotics** (motion planning, vision, walking etc.)
- **Scheduling** (timetables, assembly, machine utilization etc.)
- **Signal processing**

etc. etc.

General reference: http://www.swarmintelligence.org/

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Applications of ACO

- **Combinatorial optimization** (TSP etc.)
- **Vehicle routing**
- **Job-shop scheduling**
- ***Single-machine scheduling***
- ***Robotics***

etc. etc.

General reference: http://iridia.ulb.ac.be/~mdorigo/ACO/ACO.html

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Single-machine (weighted) total tardiness problem (SMWTTP)

- Aim: Schedule the execution of *n* jobs on a single machine.
- Tardiness of job *j* :

$$T_j = \max(0, c_j - d_j),$$

- Minimize:

$$T_{\mathrm{tot},w} = \sum_{j=1}^{n} w_j T_j .$$

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

- Ants build a sequence of jobs, such that each job is executed exactly once.

$$p(e_{ij}|S) = \frac{\tau_{ij}^{\alpha}\eta_{ij}^{\beta}}{\sum_{e_{kj}\notin L_T(S)} \tau_{kj}^{\alpha}\eta_{kj}^{\beta}},$$

- Heuristics used:
  - Shortest processing time: $\eta_{ij} = \frac{1}{t_i},$
  - Earliest due date: $\eta_{ij} = \frac{1}{d_j},$
  - Modified due date: $\eta_{ij} = \frac{1}{\max(T^{[s]} + t_j, d_j)},$

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Local search:

- Interchange:

$(1, \bar{6}, 4, 7, \bar{3}, 5, 2)$ $(1, \bar{3}, 4, 7, 6, 5, 2).$

- Insertion:

$(1, 6, 4, 7, 3, 5, 2),$ $(1, 4, \bar{7}, 3, 6, 5, 2).$

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Generating problem instances:

- Processing times chosen in [1,n]
- Due dates: integers in:

$$D = \left[\sum_{j=1}^{n} t_j \left(1 - c_1 - \frac{c_2}{2}\right), \sum_{j=1}^{n} t_j \left(1 - c_1 + \frac{c_2}{2}\right) \right],$$

- c1 = tardiness factor, c2 = relative range of due dates.

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Results

- Optimal solution found for 124 out of 125 cases (n=5), 125 of 125 (n=100) for SMTTP
- Similar results for SMTWTP

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde

Robot cooperation

- General reference: http://citeseer.ist.psu.edu/kube92collective.html

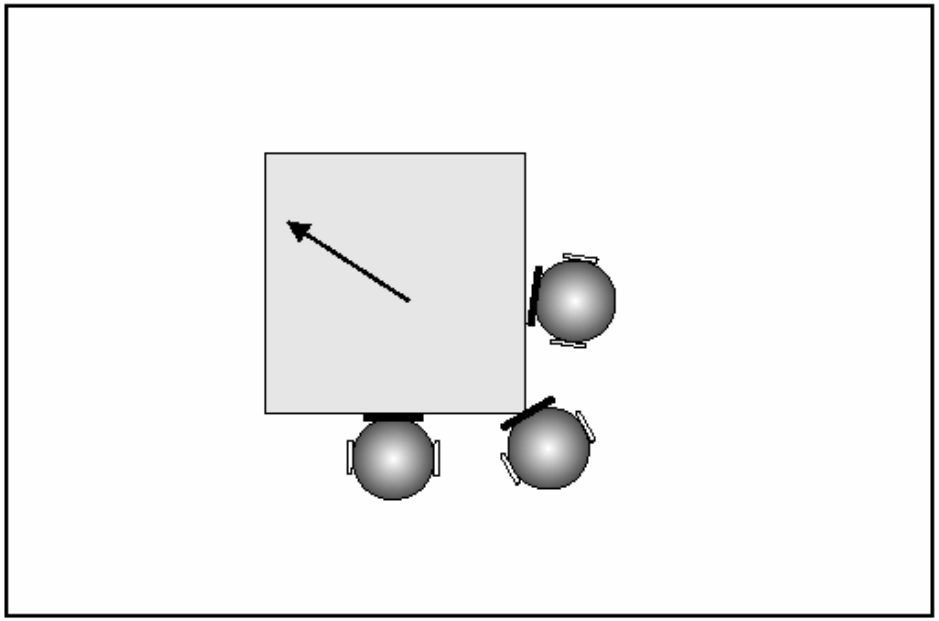


Figure 4.4: *Schematic illustration of a box-pushing task, in which three wheeled robots are attempting to move a large, rectangular box towards the edge of the arena. The arrow indicates the approximate instantaneous direction of motion.*

Mattias Wahde, PhD, associate professor, Chalmers University of Technology
e-mail: mattias.wahde@me.chalmers.se www: www.me.chalmers.se/~mwahde