Hybrid Metaheuristics

Ch. 5-5.1

Marcus Posada
Hybrid metaheuristics

Combine

- metaheuristics with metaheuristics (5.1),
- metaheuristics with exact methods (5.2),
- metaheuristics with constraint programming (5.3),
- metaheuristics with machine learning and data mining techniques (5.4).

In this chapter a taxonomy is proposed.
Hybrid Metaheuristics: Taxonomy

Hybrid metaheuristics

Level:
- Low level
- High level

Mode:
- Relay
- Teamwork

Type:
- Homogeneous
- Heterogeneous

Domain:
- Global
- Partial

Function:
- Generalist
- Specialist

Hierarchical classification

LRH

LTH

HRH

HTH

Flat classification
Low-level relay hybrid
Hybrid Metaheuristics: Taxonomy

Hierarchical classification

- Level: Low level, High level
- Mode: Relay, Teamwork
- LRH, LTH, HRH, HTH

Flat classification

- Type: Homogeneous, Heterogeneous
- Domain: Global, Partial
- Function: Generalist, Specialist
Low-level teamwork hybrid
Hybrid Metaheuristics: Taxonomy

- **Level:** Low level, High level
  - **Mode:** Relay, Teamwork
    - Low level: LRH, LTH
    - High level: Relay, Teamwork
      - HRH

- **Type:** Homogeneous, Heterogeneous
- **Domain:** Global, Partial
- **Function:** Generalist, Specialist
High-level relay hybrid
High-level relay hybrid

- P-metaheuristic
  - Population, subpopulation, best solution, and so on
- S-metaheuristic

Final (sub)population

Final (sub)population improved
Hybrid Metaheuristics: Taxonomy

Hybrid Metaheuristics

Level:
- Low level
  - Relay
  - Teamwork
    - LRH
    - LTH
- High level
  - Relay
  - Teamwork
    - HRH
    - HTH

Mode:
- Relay
- Teamwork

Type:
- Homogeneous
- Heterogeneous

Domain:
- Global
- Partial

Function:
- Generalist
- Specialist

Hierarchical classification

Flat classification
High-level teamwork hybrid

- Simulated annealing
- Genetic programming
- Evolution strategies
- Ant colonies
- Tabu search
- Bee colony
- Scatter search
- Artificial immune system
- and so on
Hybrid Metaheuristics: Taxonomy

Hybrid metaheuristics

Level:
- Low level
  - Relay: LRH
  - Teamwork: LTH
- High level
  - Relay: HRH
  - Teamwork: HTH

Mode:
- Relay
- Teamwork

Hierarchical classification

Flat classification

Type:
- Homogeneous
- Heterogeneous

Domain:
- Global
- Partial

Function:
- Generalist
- Specialist
Type: Heterogeneous

FIGURE 5.9 High-level teamwork hybridization (heterogeneous, global, general). Several search algorithms cooperate, coadapt, and coevolve a solution.
Type: Heterogeneous

FIGURE 5.10 Partial hybrid schemes. Several search algorithms cooperate in solving subproblems. A synchronization is performed to build a global solution from the partial solutions found.
Complete grammar

$$HTH(HRH(GH+LTH(GA(LS))))$$