Intelligent aircraft maintenance support system using genetic algorithms and case-based reasoning,

C. Chiu, N.-H. Chiu, C.-I. Hsu (2004)
International Journal of Advanced Manufacturing Technology 24: 440-446

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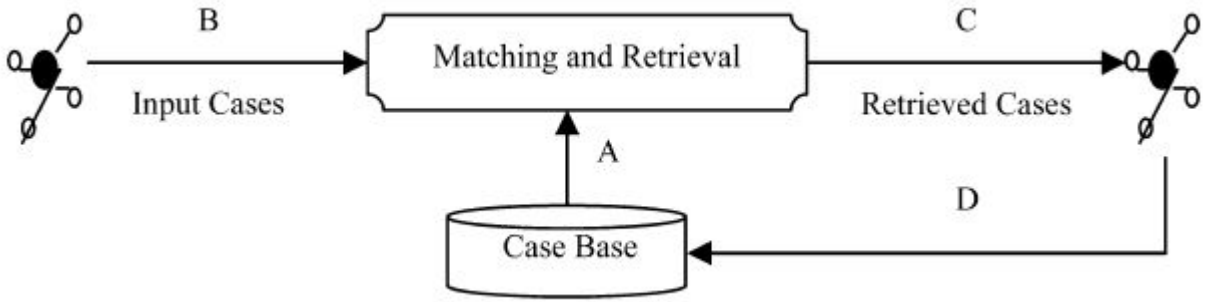
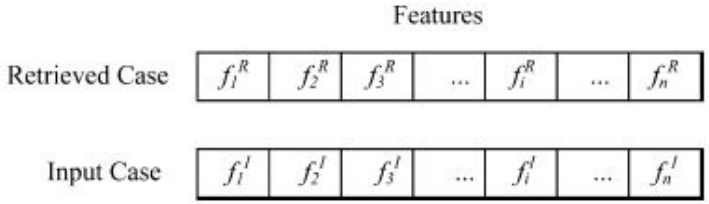
2019

Problem description

- Aircraft maintenance is one of the most important activities airlines do to improve flight safety.
- To provide reliable and effective maintenance support, it is important for the airline companies to utilise previous repair experience with the aid of advanced decision support technology.
- The maintenance records contain information about the number of defective units found, the procedures taken, and the inspection or repair status, in order to assist mechanics in identifying faults and determining the components where repair or replacement is necessary.
- CBR is a machine learning method that adapts previous similar cases to solve current problems. It is effective for complex and unstructured decision making processes.
- For the effective retrieval of previous similar cases, this research develops a CBR system with GA mechanisms used to enhance dynamic feature weighting and the design of non-similarity functions.

CBR architecture





Input features	Data type	Range
Alternating current on bright mode when electronic ballast turns on	Continuous	0 to 2 (amp)
Alternating current on dim mode when electronic ballast turns on	Continuous	0 to 2 (amp)
Alternating current on bright mode when electronic ballast turns off	Continuous	0 to 2 (amp)
Alternating current on dim mode when electronic ballast turns off	Continuous	0 to 2 (amp)
Is light unstable when electronic ballast turns on	Categorical	0 and 1
Is it not illuminated when electronic ballast turns on	Categorical	0 and 1
Outcome feature		
Components replacement	Categorical	C_1, C_2, ...,C_{10}

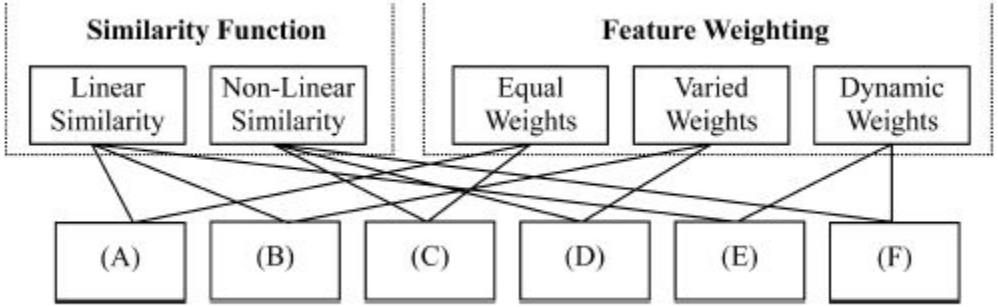
Intelligent methods

Evaluation functions for measuring the degree of similarity:

1. Linear
2. Non-linear (Genetic algorithm)

Feature weighting:

1. Static equal weights
2. Static varied weights (Genetic algorithm)
3. Dynamic weights (Genetic algorithm)



Evaluation of the CBR

- 300 Boeing 747-400 aircraft electric ballast maintenance cases gathered from the accessory shop of one major airline in Taiwan
- 200 cases for training and 100 cases for testing
- 3-fold cross validation
- Mean Error

Approach	Mean error	
	Training	Testing
(a) Linear similarity function with equal weights	0.240	0.223
(b) Linear similarity function with varied weights	0.213	0.220
(c) Non-linear similarity function with equal weights	0.207	0.210
(d) Non-linear similarity function with varied weights	0.200	0.203
(e) Linear similarity function with dynamic weights	0.233	0.230
(f) Non-linear similarity function with dynamic weights	0.193	0.180