



How to use the code of Colonial Competitive Algorithm (CCA)

Control and Intelligent Processing Center of Excellence
University of Tehran, Iran.

Esmaeil Atashpaz Gargari

Email: e.atshpaz@ece.ut.ac.ir , atashpaz_e@yahoo.com

Home Page: <http://khorshid.ut.ac.ir/~e.atashpaz>

1) A Brief Description

CCA is a novel global search heuristic that uses imperialism and imperialistic competition process as a source of inspiration. We have developed this algorithm at Control and Intelligent Processing Center of Excellence, ECE School of University of Theran. More information about this algorithm can be found at:

<http://khorshid.ut.ac.ir/~e.atashpaz/Colonial%20Competitive%20Algorithm.html>.

2) How to define the Cost Function

Lets assume that we are using the algorithm to find the global minimum of the function

$$y = f(x_1, x_2, x_3, \dots, x_{Nvar})$$

where $Nvar$ is the number of variables to be optimized, that is the dimension of the optimization problem. In the prepared code, the cost (or inversely the power) of all the countries are calculated all together. That is, to run the code for finding the global minimum of the function f , we need the function F in the following form:

$$\begin{bmatrix} y_1 \\ y_2 \\ \cdot \\ \cdot \\ \cdot \\ y_{NC} \end{bmatrix} = F\left(\begin{bmatrix} Country_1 \\ Country_2 \\ \cdot \\ \cdot \\ \cdot \\ Country_{NC} \end{bmatrix}\right) = \begin{bmatrix} f(Country_1) \\ f(Country_2) \\ \cdot \\ \cdot \\ \cdot \\ f(Country_{NC}) \end{bmatrix}$$

For example if we want to find the global minimum of the function $f(x_1, x_2) = x_1 \cdot \sin(4x_1) + 1.1x_2 \sin(2x_2)$

The function written in MATLAB should be in the following form:

```
function F1=CostFunction(x)
F1=x(:,1).*sin(4*x(:,1))+1.1*x(:,2).*sin(2*x(:,2));
```

If you have a function written in MATLAB in the following form that evaluates the cost function for all of the countries one by one, that is for the above function the cost function is written as

```
function f=CostFunction(x)
f=x(1,1)*sin(4*x(1,1))+1.1*x(1,2)*sin(2*x(1,2));
```

you can easily change it to the mentioned form by adding a for loop to your function. For example we can rewrite the above function in the following form

```
function F2=CostFunction(x)
for i = 1:size(x,1)
    F2(i)=x(i,1)*sin(4*x(i,1))+1.1*x(i,2)*sin(2*x(i,2));
end
```

Functions F1 and F2 are the same and the Colonial Competitive Algorithm can be easily applied to find their global minimum.

3) Initialization of the Parameters

The most important parameters that should be initialized are listed in the below table along with a brief description of each parameter.

ff='testfunction';	% objective function; You will use the name of your cost function here. Don't forget to put this function in the current directory.
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Npar = 2;	% number of optimization variables of your objective function. For the F1, Npar is 2.
VarLow = 0;	% variable limits
VarHigh = 10;	% variable limits. The algorithm will search for the optimum value in the interval [VarLow VarHigh] for all of the variables.
NCountries = 100;	% The number of initial countriesd.
Number_of_Imperyalists=10;	% the number of initial imperialists.
number_of_iterations = 2000;	% the number of maximum iterations.
alpha = .1;	% alpha is a number in the interval of [0 1] but alpha<<1. alpha denotes the importance of the mean of colonies' power compare to the power of imperialist state.
mutation_rate = 0.3;	% The percentage of countries that due to phenomena like revolution suddenly change their state.
Assimilation-Coefficient=2;	% is the same "beta" in the paper (CEC2007).
AssimilationAngle-Coefficient = .5;	% is the "gama" in the paper (CEC2007).