The study of neurodynamic systems of continuous adaptive control

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Welcome to Web Services for Decision Support Systems!

On this portal there are a lot of methods to support decision-making and operations research including methods of multiple-criteria decision analysis and optimization methods. All methods are available for free through RESTful API after registration.

Download RESTful API manual Example

Main available methods:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>aircraft_schedule</td>
<td>The solution to the problem of finding the shortest path in a graph by the ant colony method. The input data are represented as: { &quot;from_vertex&quot;: &quot;&lt;the name of the initial vertex&gt;&quot;, &quot;to_vertex&quot;: &quot;&lt;the name of the destination of the final vertex&gt;&quot;, &quot;graph&quot;:{ &quot;name initial vertices&quot;: { &quot;name input vertices 1&quot;: &lt; arc length &gt;, &quot;the name of the incoming vertex 2&quot;: &lt; the length of the arc &gt; }, ...... }</td>
</tr>
<tr>
<td>ant_colony</td>
<td>Realization of the Bellman-Ford algorithm. The Bellman-Ford algorithm is designed to solve the problem of finding the shortest path on a graph. The algorithm finds the shortest distance for a given weighted graph from the selected source vertex to all other vertices of the graph. Its distinctive feature is its applicability to graphs with arbitrary including negative weights. The input data contain: an array of edges &quot;graph&quot; each of which consists of the vertex &quot;from&quot;, the vertex &quot;to&quot; and the weight of the edge; the number of the initial vertex &quot;vertex&quot; for which the search is performed; the variable &quot;isDirect&quot; which can take the values 1 and 0, depending on whether the graph is oriented or not. Software implementation: N. Khrapov.</td>
</tr>
<tr>
<td>bellman_ford</td>
<td></td>
</tr>
<tr>
<td>concordance</td>
<td></td>
</tr>
<tr>
<td>consistency_increase</td>
<td></td>
</tr>
<tr>
<td>eulerian_path</td>
<td>Search for the Eulerian path in an undirected graph. It's necessary to specify an array of edges. Optional parameter: the number of the initial vertex. {&quot;Graf&quot;: [[1,2], [2,3]], &quot;initial&quot;: 1}</td>
</tr>
<tr>
<td>Model Type</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Weighted sum choice model</td>
<td>The model allows one to determine the ranks of alternatives.</td>
</tr>
<tr>
<td>The model of choice based on the HPF</td>
<td>The model of choice based on the hybrid preference function (HPF). The model allows one to determine the ranks of alternatives based on a hybrid preference function. The research was carried out within the framework of the federal target program &quot;Research and development on priority areas of development of the scientific and technological complex of Russia for 2014-2020&quot;, Agreement No. 14.604.21.0052 dated June 30, 2014 with the Ministry of Education and Science. The unique identifier of the project is RFMEF60414X0052.</td>
</tr>
<tr>
<td>The Model of Pareto-Optimal Solutions</td>
<td>Assigns rank 1 to pareto-optimal solutions and rank 0 to dominant ones.</td>
</tr>
<tr>
<td>BPR-model of transport network</td>
<td>The model describes the transport network. The cost function for traveling along an arc is determined by the classical BPR function: ( travel_time (flow) = free_flow_time \times (1 + B \times (flow / capacity) ^ P) ). The input of the model serves a network graph and a set of correspondences. The output returns the distribution of the flows along the arcs (the equilibrium state). Software implementation of the model: Anikin AS. The research was carried out within the framework of the federal target program &quot;Research and development in priority areas of development of the scientific and technological complex of Russia for 2014-2020&quot;, Agreement No. 14.604.21.0052 dated June 30, 2014 with the Ministry of Education and Science. The unique identifier of the project is RFMEF60414X0052.</td>
</tr>
</tbody>
</table>
**Parameters**

**Name:** The model of choice based on the HPF

**Description:** The model of choice based on the hybrid preference function (HPF). The model allows one to determine the ranks of alternatives based on a hybrid preference function. The research was carried out within the framework of the federal target program "Research and development on priority areas of development of the scientific-technological complex of Russia for 2014-2020", Agreement No. 14.604.21.0052 dated June 30, 2014 with the Ministry of Education and Science. The unique identifier of the project is RFMEFI60414X0052.

**Url:**

**Internal method:** GFP

**Accessibility:** public

**Model parameters**

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<th>Description</th>
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</tr>
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</table>
A conceptual model of integrated computing complex

EVOLUTIONARY DYNAMICS OF ADAPTIVE ND-SYSTEM

- Space behavior
- Dynamic catastrophe theory
- Space management

Management of the processes of adaptation of evolutionary dynamics of ND-interval system implementation

Fuzzy formal system

- Building scripts behaviour based on ND-system
- Problem identification based on ND-system
- The problem of approximation based on ND-system
- Building scripts ND-based management system
- The problem of prediction and control based on ND-system
Spiral structure and model that implements the strategic planning of operations

Analysis of baseline data

Designing Neural Networks

Implementation and testing of Neural Networks

Function interpretation

Physical modeling

The preferred model

Hypotheses and assumptions

Neural network Predictor

Version 1

Version 2

Version 3

Strategic planning of operations when building neural network models in a non-stationary environment

Definition of objectives and constraints

Build a hierarchy of neural networks

Functional space

Definition of functions of interpretation

Choosing the best model
Neural network ensemble implements the model climate spectra of sea excitement
The structure of neural network ensemble implementing the transformation operator of complex signals when controlling complicated situations

Radial basis function network – Perceptron – Kohonen's network
Control of the object dynamics in the process of system evolution

• controls the equilibrium parameters of the sea dynamic object:
  – careen,
  – trim,
  – draft by the nose and stern,

• forecast of:
  – the safe speed,
  – the course angle of the wave
depending on the intensity of external disturbances
NEURO-FUZZY model

Instead of setting preference areas for decision makers, a neural network with fuzzy rules is trained:
Model of a logical conclusion according to a precedent

Neural networks ensemble

Neural network technology in the analysis of precedents

Analysis of precedents

Testing of precedent

Knowledge base of precedents

Selection of precedent

Conceptual and expert knowledge base

The control unit
Scheme of modeling evolutionary dynamics of complex systems

Realization of dynamic model of disasters
- Analytical interpretation
- Geometric interpretation
- High-performance computing
- The management model
  - GRID-Technologie
  - Cloud-Technologie
  - Assessment of the status of the object
  - Formation of control actions
  - Decision-making unit
  - The dynamics of the external environment

Interpreting model ND-system
- Structural synthesis model
- Parametric synthesis model
- Assessment of efficiency of model
- Functional block of synthesis of model
  - Multicriteria optimization
  - Neural network approximation
  - Control the evolution of the system
  - Adjusting the forecast model
Results of the NEURO-FUZZY model

```r
nrt <- .RinRuby$get_value()
.RinRuby$parse.string <- .RinRuby$get_value()
.RinRuby$parseable(.RinRuby$parse.string)

require("parallel")
require("anfis")
X <- matrix(x,ncol=nc,nrow=nr)
Y <- matrix(y,ncol=1,nrow=4)
membershipFunction<-list(
x=c(new(Class="NormalizedGaussianMF",parameters=c(mu=0.25,sigma=0.3)),
  new(Class="NormalizedGaussianMF",parameters=c(mu=0.5,sigma=0.3)),
  new(Class="NormalizedGaussianMF",parameters=c(mu=0.75,sigma=0.3))),
  y=c(new(Class="NormalizedGaussianMF",parameters=c(mu=0.25,sigma=0.3)),
    new(Class="NormalizedGaussianMF",parameters=c(mu=0.5,sigma=0.3)),
    new(Class="NormalizedGaussianMF",parameters=c(mu=0.75,sigma=0.3)))
  anfis3 <- new(Class="ANFIS",X,Y,membershipFunction)
  trainOutput <- trainHybridJangOffline(anfis3, epochs=10)
[1]  "epoch": 1
[1]  "epoch": 2
[1]  "epoch": 3
[1]  "epoch": 4
[1]  "epoch": 5
[1]  "epoch": 6
[1]  "epoch": 7
[1]  "epoch": 8
[1]  "epoch": 9
X <- matrix(t,ncol=nc,nrow=nrt)
ytest <- c(predict(anfis3,X))
print("RINRUBY.EVAL.FLAG")
[0.5152844385912677, 0.0006224513273620971]

Error/check code: 0/0/0
Created at: 2019-12-04 19:43:11 +0300
Changed at: 2019-12-04 19:43:14 +0300
```
Interaction scheme

- **WS-DSS / RoR**
  - **Redis / NoSQL**
  - **Sidekiq**
    - **neuro_fuzzy / Ruby rinruby**
      - **ANFIS / R**
Leaning: Neural network training

Is there an airplane in the picture?
Prospects

Let's integrate your models
Write me: sudakov@ws-dss.com

Thanks for attention!