



Keldysh Institute of Applied Mathematics
(Russian Academy of Sciences)

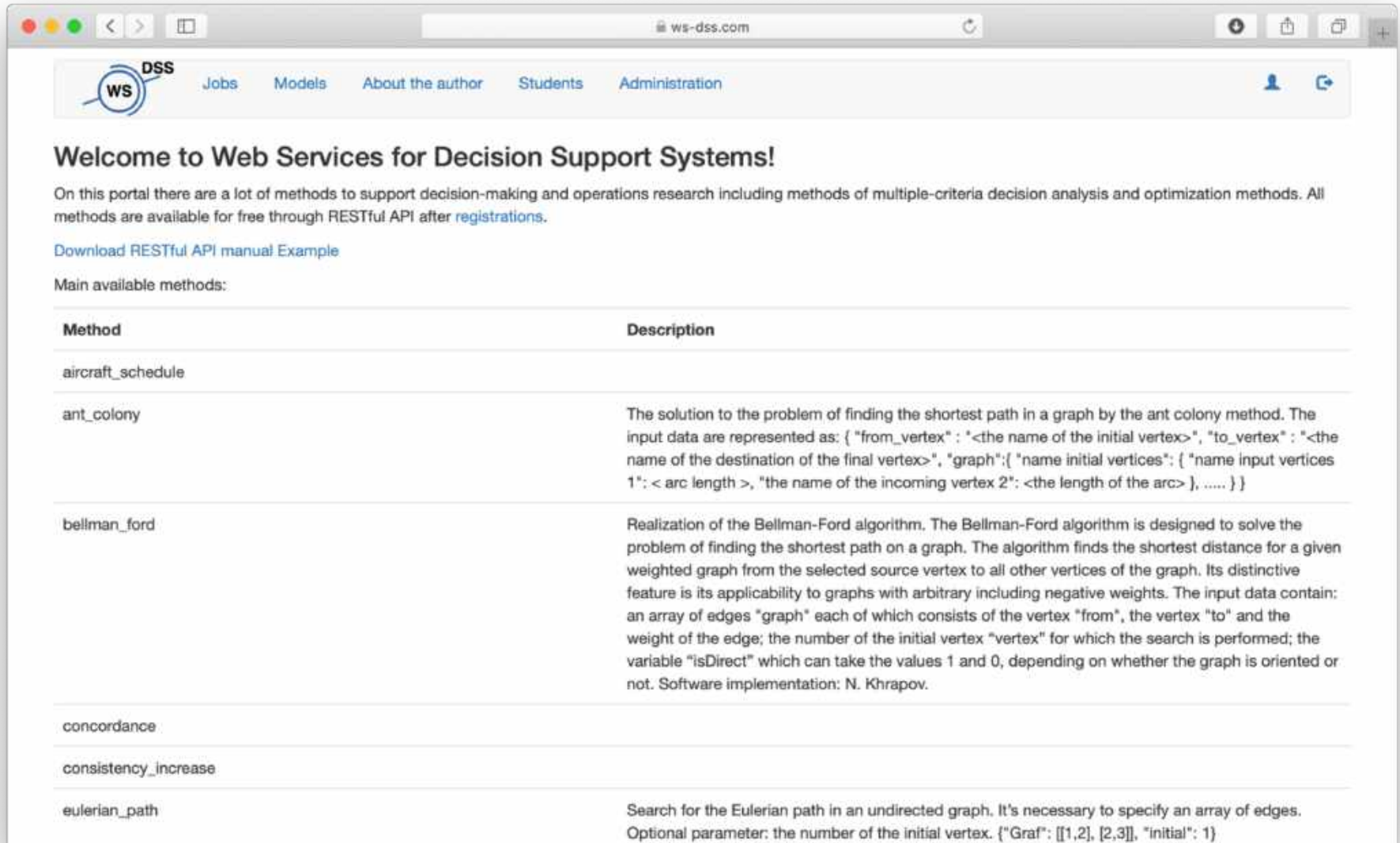
The study of neurodynamic systems of continuous adaptive control

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Alexander Vasilyev, Yuri Nechaev

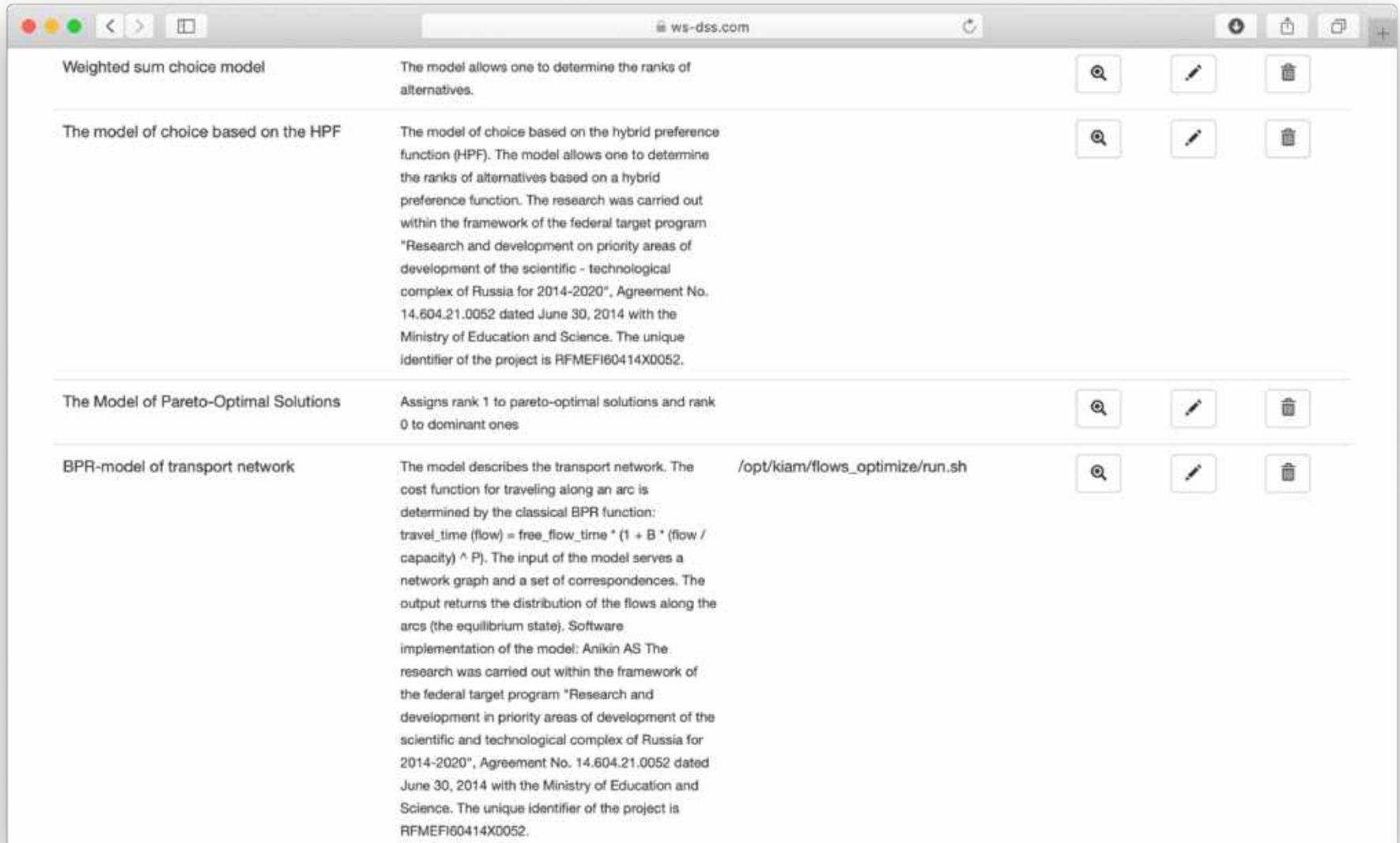
WS-DSS.COM



The screenshot shows a web browser window with the URL ws-dss.com. The page features a navigation menu with links for Jobs, Models, About the author, Students, and Administration. A logo with 'WS' and 'DSS' is visible. The main heading is 'Welcome to Web Services for Decision Support Systems!'. Below this, a paragraph explains the portal's purpose and provides a link to download a RESTful API manual. A section titled 'Main available methods:' lists several methods in a table.

Method	Description
aircraft_schedule	
ant_colony	The solution to the problem of finding the shortest path in a graph by the ant colony method. The input data are represented as: { "from_vertex" : "<the name of the initial vertex>", "to_vertex" : "<the name of the destination of the final vertex>", "graph":{ "name initial vertices": { "name input vertices 1": < arc length >, "the name of the incoming vertex 2": <the length of the arc> }, } }
bellman_ford	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 "graph" each of which consists of the vertex "from", the vertex "to" and the weight of the edge; the number of the initial vertex "vertex" for which the search is performed; the variable "isDirect" which can take the values 1 and 0, depending on whether the graph is oriented or not. Software implementation: N. Khrapov.
concordance	
consistency_increase	
eulerian_path	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. {"Graf": [[1,2], [2,3]], "initial": 1}

Models in WS-DSS

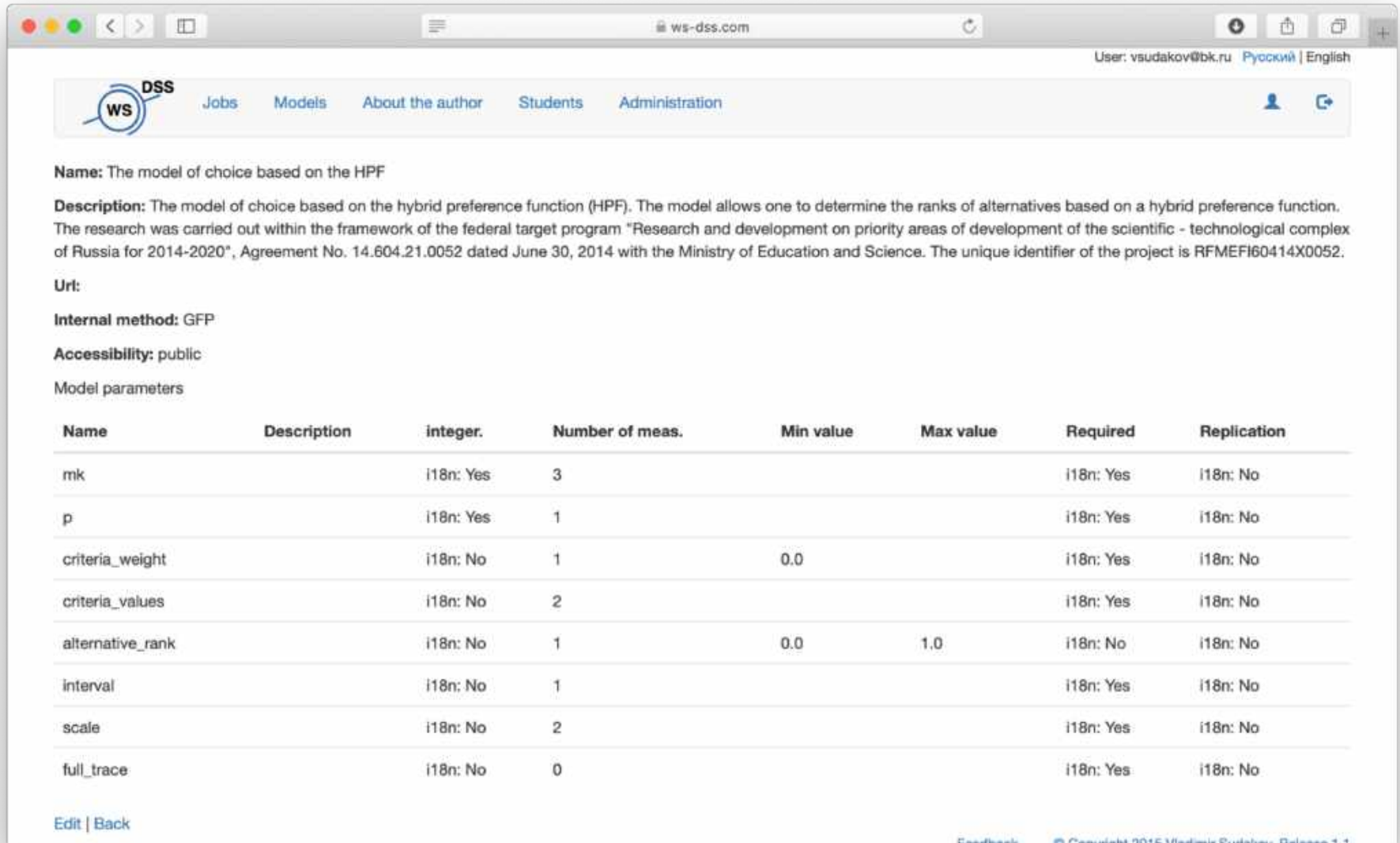


The screenshot shows a web browser window with the URL ws-dss.com. The page displays a list of four models, each with a title, a description, and a set of three icons (search, edit, delete) to the right. The models are:

Model Name	Description	Actions
Weighted sum choice model	The model allows one to determine the ranks of alternatives.	Search, Edit, Delete
The model of choice based on the HPF	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.	Search, Edit, Delete
The Model of Pareto-Optimal Solutions	Assigns rank 1 to pareto-optimal solutions and rank 0 to dominant ones	Search, Edit, Delete
BPR-model of transport network	The model describes the transport network. The cost function for traveling along an arc is determined by the classical BPR function: $\text{travel_time}(\text{flow}) = \text{free_flow_time} * (1 + B * (\text{flow} / \text{capacity}) ^ P)$ 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 "Research and development in priority areas of development of the scientific and 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.	Search, Edit, Delete

The BPR-model entry also includes a code snippet: `/opt/kiam/flows_optimize/run.sh`

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

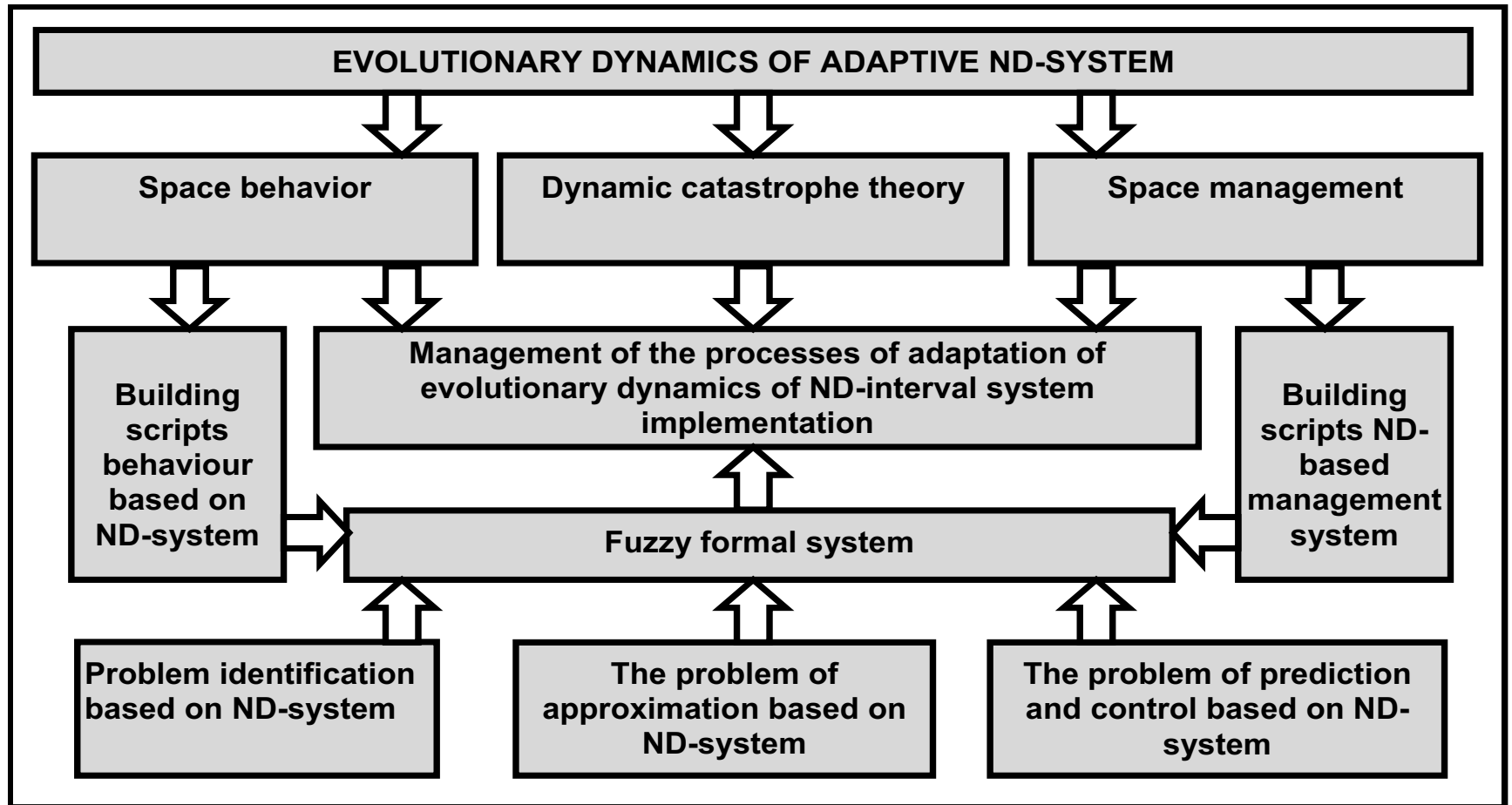
Model parameters

Name	Description	integer.	Number of meas.	Min value	Max value	Required	Replication
mk		i18n: Yes	3			i18n: Yes	i18n: No
p		i18n: Yes	1			i18n: Yes	i18n: No
criteria_weight		i18n: No	1	0.0		i18n: Yes	i18n: No
criteria_values		i18n: No	2			i18n: Yes	i18n: No
alternative_rank		i18n: No	1	0.0	1.0	i18n: No	i18n: No
interval		i18n: No	1			i18n: Yes	i18n: No
scale		i18n: No	2			i18n: Yes	i18n: No
full_trace		i18n: No	0			i18n: Yes	i18n: No

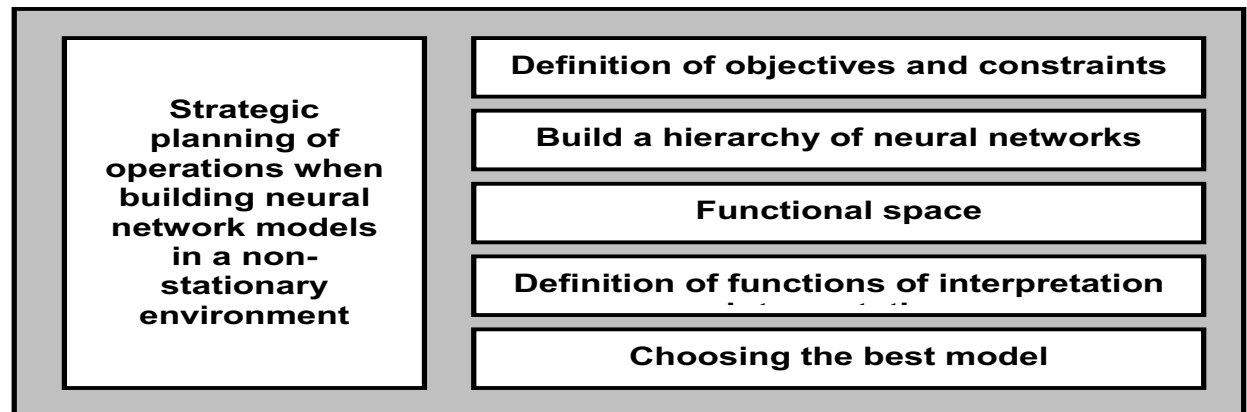
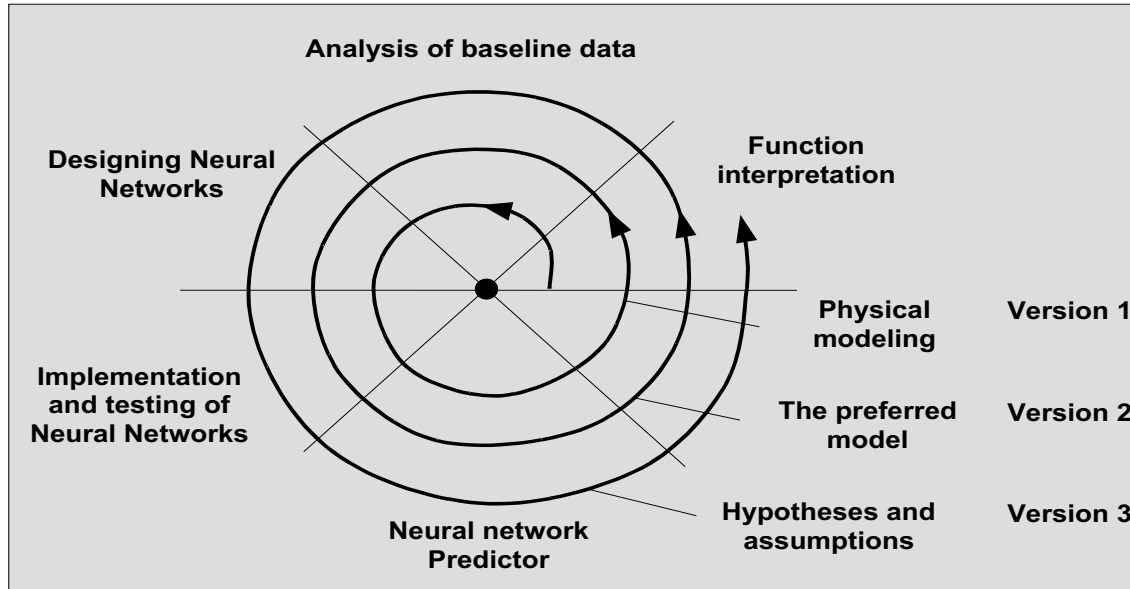
[Edit](#) | [Back](#)

[Feedback](#) | © Copyright 2015 V/Adimir Sudakov. Release 1.1

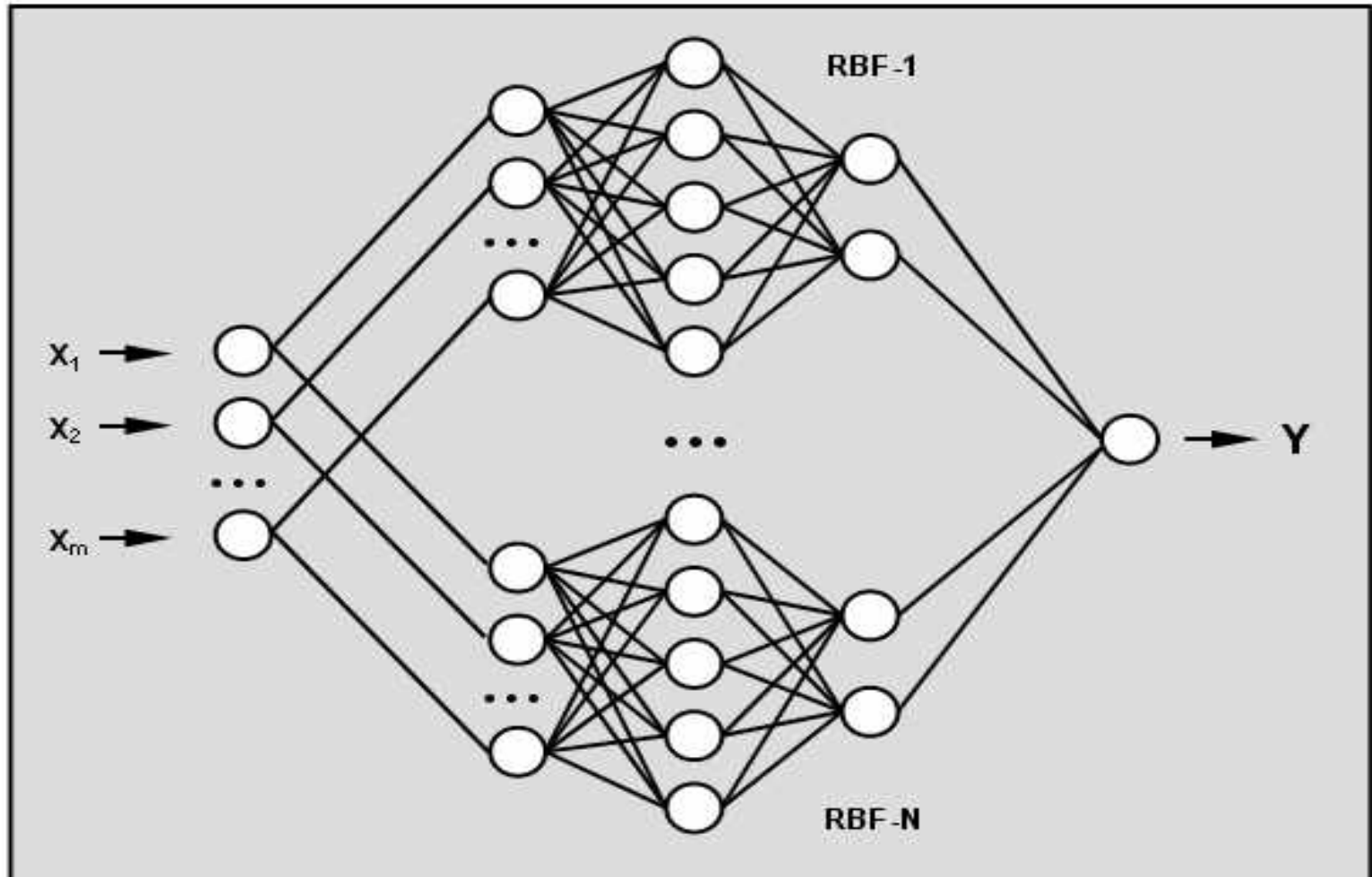
A conceptual model of integrated computing complex



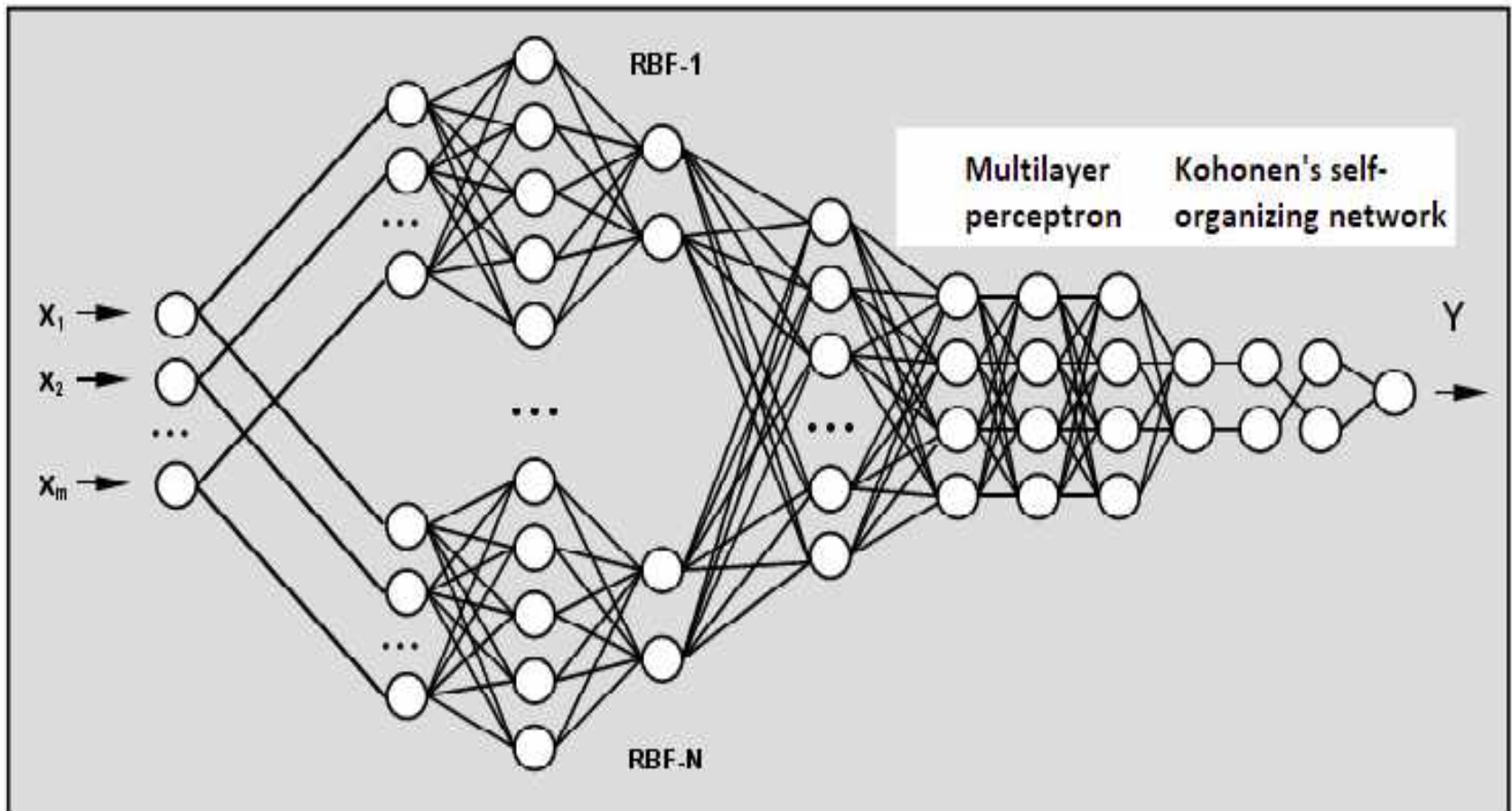
Spiral structure and model that implements the strategic planning of operations



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



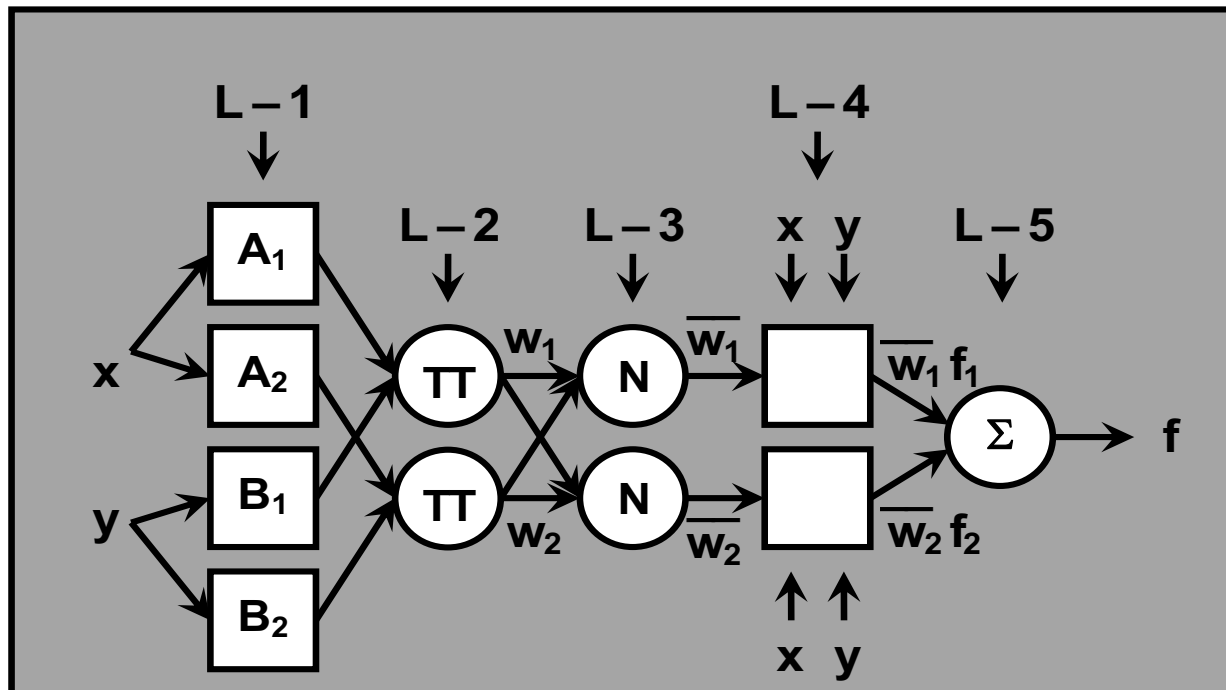
Radial basis function network – Perceptron – Kohonen's network

Control of the object dynamics in the process of system evolution

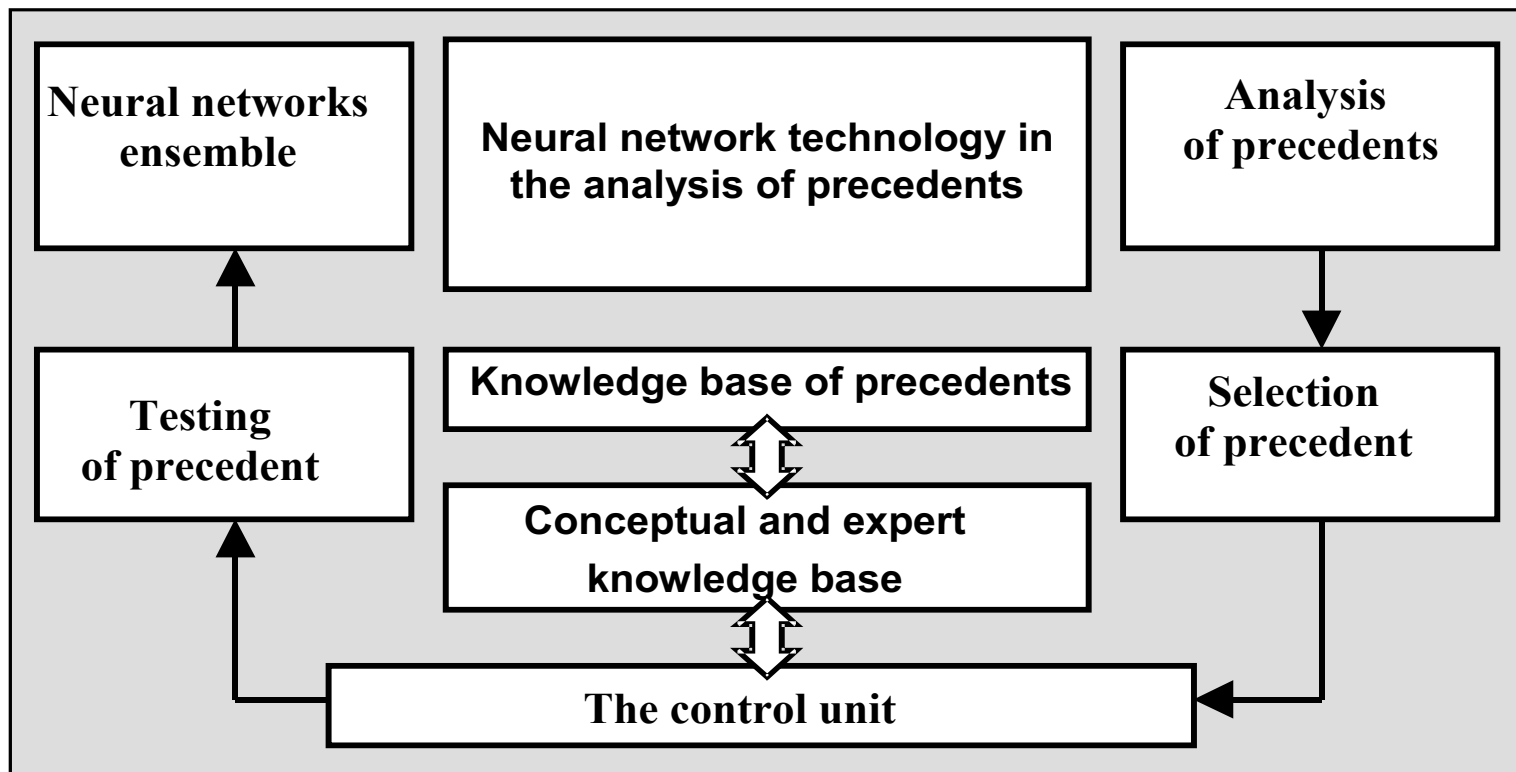
- controls the equilibrium parameters of the sea dynamic object:
 - careen,
 - trim,
 - draft by the nose and stern,
- forecast of
 - the safe speed,
 - the course angle of the wavedepending on the intensity of external disturbances

NEURO-FUZZY model

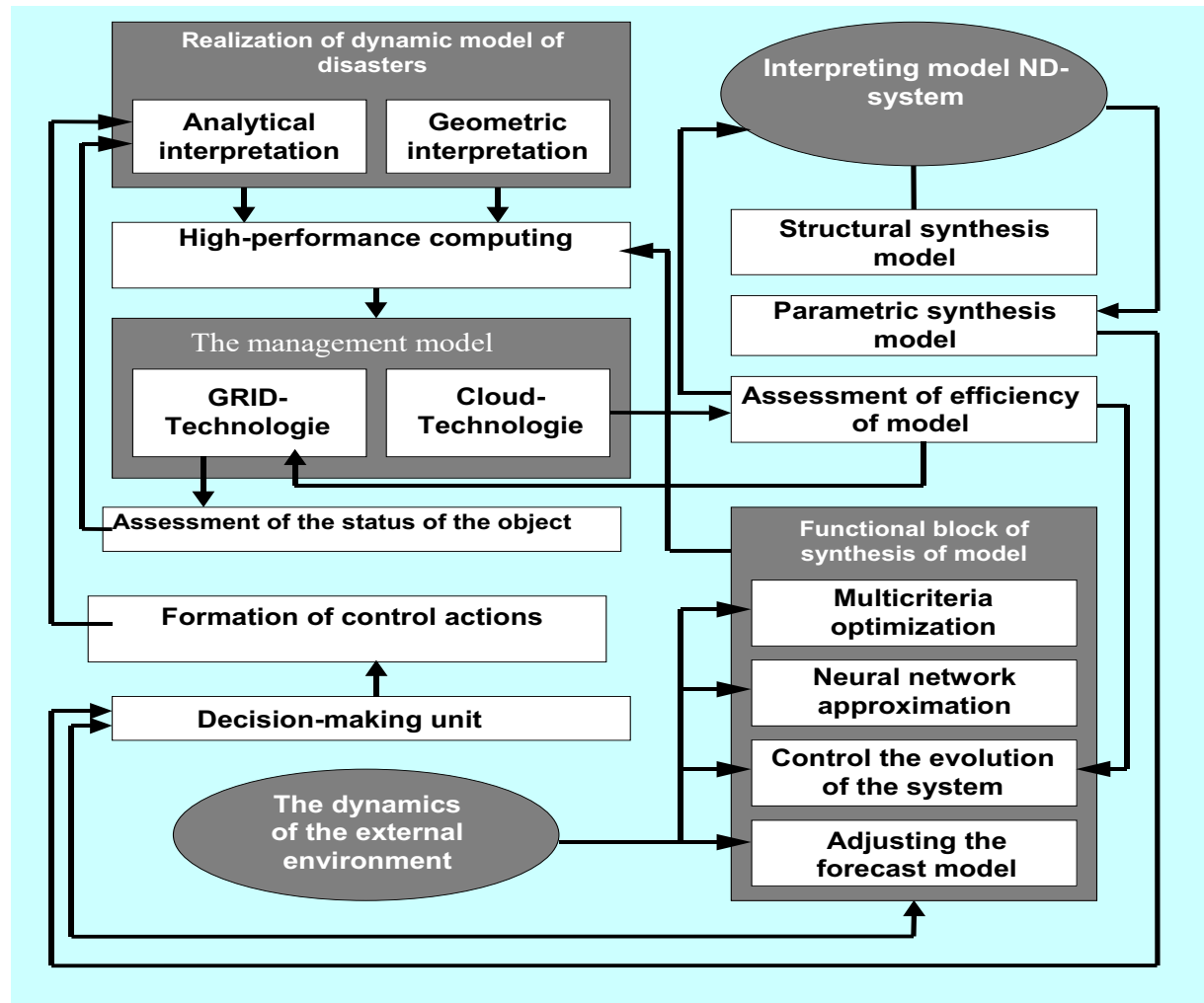
Instead of setting preference areas for decision makers, a neural network with fuzzy rules is trained:



Model of a logical conclusion according to a precedent



Scheme of modeling evolutionary dynamics of complex systems



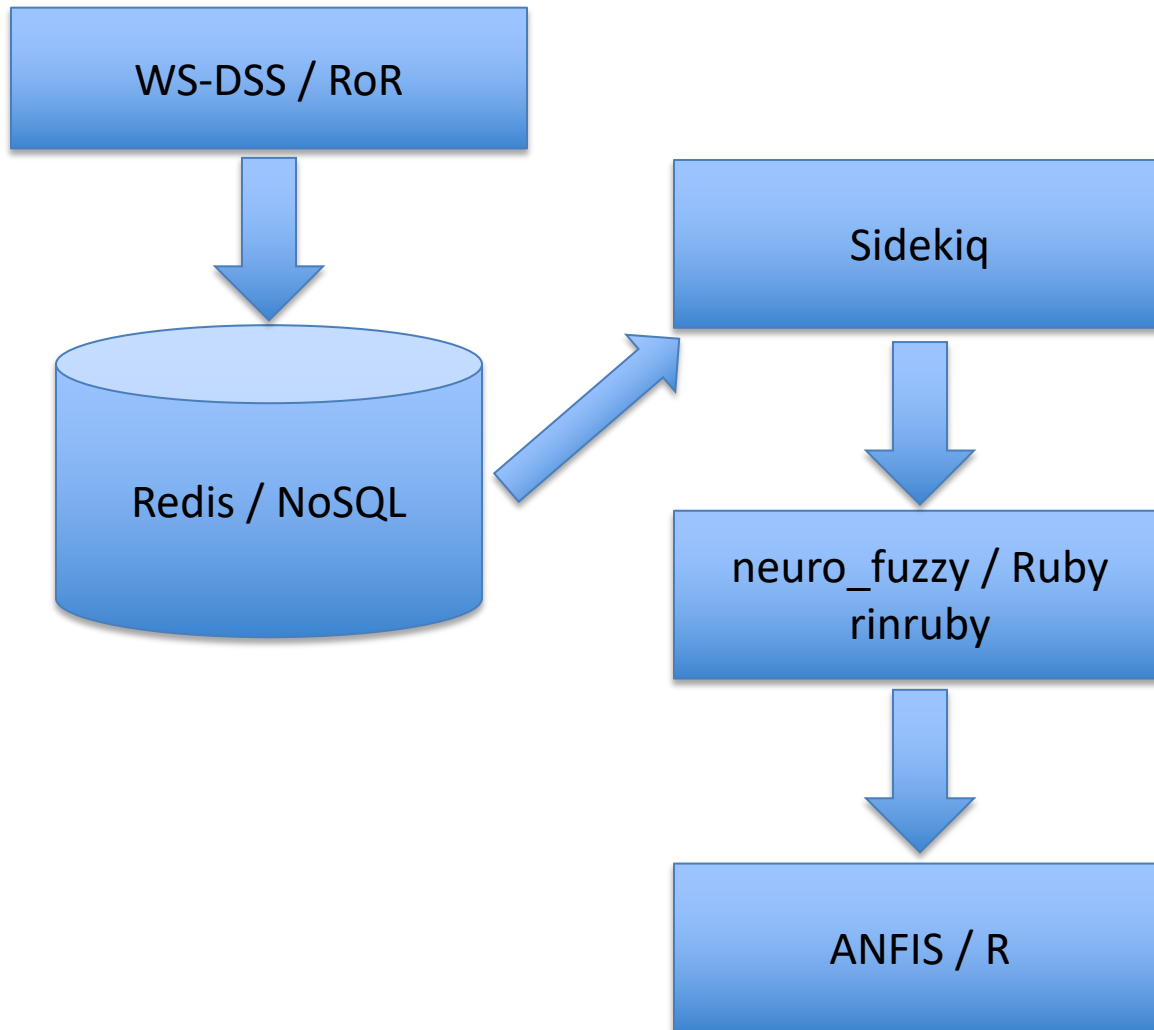
Results of the NEURO-FUZZY model

```
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]
```

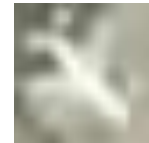
Error/check code: 0/0/0
Created at: 2019-12-04 19:43:11 +0300
Changed at: 2019-12-04 19:43:14 +0300

Interaction scheme



Leaning: Neural network training

Is there an airplane in the picture?



Method: airplane_cnn
User: sudakov@ws-dss.com
Input data:

```
{
  "n_layers": 1,
  "min_neurons": 20,
  "max_neurons": 100,
  "epochs": 1,
  "batch_size": 200
}
```

Output data:

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 18, 18, 20)	560
activation_1 (Activation)	(None, 18, 18, 20)	0
max_pooling2d_1 (MaxPooling2)	(None, 9, 9, 20)	0
flatten_1 (Flatten)	(None, 1620)	0
dense_1 (Dense)	(None, 100)	162100
activation_2 (Activation)	(None, 100)	0
dense_2 (Dense)	(None, 1)	101
activation_3 (Activation)	(None, 1)	0

Total params: 162,761
Trainable params: 162,761
Non-trainable params: 0

Accuracy: 0.855
Your bonus is: 54.99999999999964 -33.0 = 21.99999999999964

Error/check code: 0/22/0

TensorSpace Airplane
A PEN BY Vladimír Sudakov

HTML

```
src="https://tensor-space.org/assets/jslib/tensor-space.min.js">
</script>
```

JS

```
filters: 0, strides: 1 ] ] );
model.add( new TSP.layers.Conv2d( { shape : [ 18, 18, 20 ] } ) );
);
model.add( new TSP.layers.Activation3d( { shape : [ 18, 18,
```

Prospects

Let's integrate your models

Write me: sudakov@ws-dss.com

Thanks for attention!