

commands to said aircraft and if applicable communicates with the controllers of the neighboring sectors via their respective ATM system.

When the conflict detection method changes, for example by using a new conflict detection algorithm, tests are carried out, including supplying the ATM system with input data that are next processed and/or displayed, analyzing them via the air traffic controller, providing instructions via the latter, then processing these instructions via the ATM system, the behavior of the system being supervised in order to detect inconsistencies, drifts, regressions, etc.

Another functionality of an ATM system is for example the supervision of the safety distances between aircraft. When the retrieval form of this functionality changes, tests must also be carried out.

There is therefore a need to facilitate the implementation of tests for air traffic control electronic control systems.

To that end, according to a first aspect, the invention proposes a test method for an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the a~~ state of the air traffic control received by said system, said system further receiving, and processing, in ~~the an~~ operational phase, control instructions from air traffic control that are provided to it by at least one air traffic controller, said method being characterized in that it comprises, during a test phase of said system, the following steps:

- reception by said system of input data representative of ~~the a~~ state of air traffic;
- establishment by said system of information relative to the air traffic as a function of said input data and delivery by said system of said information to an electronic test device of the system;
- determination by said electronic test device of the system, as a function of the delivered information, of ~~the~~ air traffic control instructions and providing said system with said instructions;
- reception and processing of said instructions by said system;

according to which said electronic device includes an algorithmic model for automatically determining instructions as a function of information relative to the air traffic, said model having been obtained during a learning phase, carried out by computer, of a deep learning neural network, as a function of a set of instructions previously provided by at least one air traffic controller to the system and information relative to the air traffic associated with said instructions.

- determining the algorithmic model for automatically determining instructions as a function of information relative to the air traffic controller by learning, carried out by computer, of a neural network, as a function of said stored set of instructions and said stored information relative to the air traffic and associated with said instructions.

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According to a second aspect, the present invention proposes an electronic test device for an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~a state of the air traffic control received by said system, said system further receiving, and processing control instructions from air traffic control that are provided to it by at least one air traffic controller,

said electronic test device being characterized in that it is adapted for receiving information relative to ~~the~~an air traffic delivered by the system and in that it includes an algorithmic model for automatically determining instructions as a function of information relative to the air traffic, said model having been obtained during a learning phase, carried out by computer, of a deep learning neural network, as a function of a set of instructions previously provided by at least one air traffic controller to the system and information relative to the air traffic associated with said instructions.

In embodiments, the test device according to the invention further includes one or more of the following features:

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- it is adapted for detecting the nonconformity of the system as a function of the behavior of the system;
- the algorithmic model for automatically determining instructions has been learned in order to determine instructions specific to at least one element, as a function of a determination by element from among several elements of the same type, during the learning of the instructions previously provided by at least one air traffic controller to the system and of the information relative to the air traffic control associated with said instructions, said element from among several elements of the same type being a geographical sector from among several geographical sectors and/or an air traffic controller role from among several roles and/or a functionality of the electronic control system of the air traffic from among several functionalities of said system.

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According to a third aspect, the present invention proposes a test platform for an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~a state of the air traffic

control received by said system, said system further receiving, and processing, in ~~the~~an operational phase, control instructions from air traffic control that are provided to it by at least one air traffic controller,

said platform being adapted for collecting and storing a set of instructions previously provided to the system by the at least one air traffic controller and information relative to the air traffic ~~controller~~ delivered by the system associated with said instructions;

- determining the algorithmic model for automatically determining instructions as a function of information relative to the air traffic ~~controller~~delivered by the system associated with said instruction by learning, carried out by computer, of a neural network, as a function of said stored set of instructions and said stored information relative to the air traffic and associated with said instructions;

- obtaining an electronic test device of the system including said algorithmic model for automatically determining instructions;

- testing said system via said electronic test device.

According to a fourth aspect, the present invention proposes a test platform including:

- an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~a state of the air traffic control received by said system, said system further receiving, and processing control instructions from air traffic control that are provided to it by at least one air traffic controller; and
- an electronic test device of said electronic system according to one of the claims according to the second aspect of the invention.

These features and advantages of the invention will appear upon reading the following description, provided solely as an example, and done in reference to the appended drawings, in which:

- figure 1 shows a view of a test platform in one embodiment of the invention;
- figure 2 is a flowchart of steps implemented in one embodiment of the invention.

Figure 1 shows a test platform 1 of an air traffic control electronic control system. In the considered example, the test platform 1 includes an air traffic control electronic control system 2, called ATM system 2 hereinafter, and an electronic test device 6.

The ATM system 2 includes a memory 20, an MMI unit 21 and a processor 22.

The MMI unit 21 for example includes display screens, for instance touch-sensitive, a speaker system, a keyboard, a microphone, etc.

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Furthermore, the ATM system 2 is connected by telecommunication links to a set 4 of outside systems 4_1, 4_2, ..., 4_n.

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CLAIMS

1.- A test method for an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~a state of the air traffic control received by said system, said system further receiving, and processing, in ~~the~~an operational phase, air traffic control instructions that are provided to it by at least one air traffic controller,

said method being characterized in that it comprises, during a test phase of said system, the following steps:

- reception by said system of input data representative of ~~the~~a state of air traffic;
- establishment by said system of information relative to the air traffic as a function of said input data and delivery by said system of said information to an electronic test device of the system;
- determination by said electronic test device of the system, as a function of the delivered information, of ~~the~~air traffic control instructions and providing said system with said instructions;
- reception and processing of said instructions by said system;

according to which said electronic device includes an algorithmic model for automatically determining instructions as a function of information relative to the air traffic, said model having been obtained during a learning phase, carried out by computer, of a deep learning neural network, as a function of a set of instructions previously provided by at least one air traffic controller to the system and information relative to the air traffic associated with said instructions.

2.- The test method for an ~~electronic~~-air traffic ~~control~~ electronic control system according to claim 1, comprising, during the test phase, the detection of one or more nonconformities of the system as a function of ~~the~~a behavior of the system.

3.- The test method for an ~~electronic~~-air traffic control electronic control system according to claim 1 or 2, the algorithmic model for automatically determining instructions has been learned in order to determine instructions specific to at least one element, as a function of a determination by element from among several elements of the same type, during the learning of the instructions previously provided by at least one air traffic controller to the system and of the information relative to the air traffic ~~control~~-associated with said instructions, said element from among several elements of the same type being a geographical sector from among several geographical sectors and/or an air traffic

controller role from among several roles and/or a functionality of the electronic control system of the air traffic from among several functionalities of said system.

4.- ~~A~~The test method for ~~testing~~an air traffic ~~control management~~electronic ~~control~~ system according to one of claims 1 to 3, comprising the steps of:

- determining an algorithmic constraint module adapted for identifying instructions not compliant with ~~the~~rules of the air traffic controllers;
- applying said algorithmic module to the set of instructions previously supplied by at least one air traffic controller to the system and removing said instructions identified as not compliant from the set used for the learning of the neural network;
- applying said algorithmic module to the instructions determined by the electronic test device and not considered~~ed~~ing, in the test phase~~for testing~~, instruction(s) identified as not compliant.

5.- The test method for an ~~electronic~~air traffic control electronic control system according to one of claims 1 to 4, comprising, in a phase preliminary to the test, the steps of:

- collecting and storing a set of instructions previously provided to the system by at least one air traffic controller and information relative to the air traffic ~~controller~~delivered by the system associated with said instructions;
- determining the algorithmic model for automatically determining instructions as a function of information relative to the air traffic ~~controller~~delivered by the system associated with said instruction by learning, carried out by computer, of a neural network, as a function of said stored set of instructions and said stored information relative to the air traffic and associated with said instructions.

6.- An electronic test device of an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~a state of the air traffic control received by said system, said system further receiving, and processing air traffic control instructions that are provided to it by at least one air traffic controller,

said electronic test device being characterized in that it is adapted for receiving information relative to ~~the~~an air traffic delivered by the system and in that it includes an algorithmic model for automatically determining instructions as a function of information relative to the air traffic, said model having been obtained during a learning phase, carried out by computer, of a deep learning neural network, as a function of a set of instructions

previously provided by at least one air traffic controller to the system and information relative to the air traffic associated with said instructions.

7.- The electronic test device according to claim 6, adapted for detecting the nonconformity of the system as a function of ~~thea~~ behavior of the system.

5 8.- The electronic test device according to claim 6 or 7, wherein the algorithmic model for automatically determining instructions has been learned in order to determine instructions specific to at least one element, as a function of a determination by element from among several elements of the same type, during the learning of the instructions previously provided by at least one air traffic controller to the system and of the information relative to
10 the air traffic ~~control~~ associated with said instructions, said element from among several elements of the same type being a geographical sector from among several geographical sectors and/or an air traffic controller role from among several roles and/or a functionality of the electronic control system of the air traffic from among several functionalities of said system.

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9.- A test platform for an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~thea~~ state of the air traffic control received by said system, said system further receiving, and processing, in ~~thean~~ operational phase, air traffic control instructions that are provided to it
20 by at least one air traffic controller,

said platform being adapted for collecting and storing a set of instructions previously provided to the system by ~~the~~ at least one air traffic controller and information relative to the air traffic ~~controller~~ delivered by the system associated with said instructions;

- determining the algorithmic model for automatically determining instructions as a
25 function of information relative to the air traffic ~~controller~~ delivered by the system associated with said instruction by learning, carried out by computer, of a neural network, as a function of said stored set of instructions and said stored information relative to the air traffic and associated with said instructions;

- obtaining an electronic test device of the system including said algorithmic model for
30 automatically determining instructions;

- testing said system via said electronic test device.

10.- A test platform including:

- an air traffic control electronic control system delivering information relative to air traffic control established as a function of input data representative of ~~the~~ea state of the air traffic control received by said system, said system further receiving, and processing control instructions from air traffic control that are provided to it by at least one air traffic controller; and
- an electronic test device of said electronic system according to one of claims 6 to 8.