Claims

1. System (1) for dynamically adapting a passenger transport capacity of a transport line (L1-L3) to a number of passengers of the transport line (L1-L3), said transport line comprising at least two stations (S1-S15), each station (S1-S15) comprising at least one platform served by transport vehicles (V1-V12) of the transport line, said system (1) comprising:
   - a main evaluation unit (10) configured for automatically determining, in function of the time, said number of passengers of the transport line (L1-L3);
   - a processing unit (13) configured for receiving or acquiring the following input data:
     - said number of passengers in function of the time;
     - a nominal timetable for the transport line;
     - a nominal passenger transport capacity of each transport vehicle (V1-V12) of the transport line (L1-L3) that can serve said platforms;

   and for applying a trained function to said number of passengers in function of the time, wherein said trained function has been trained by a machine learning algorithm for automatically predicting a future temporal evolution of said number of passengers, the processing unit (13) being further configured for automatically determining, from said future temporal evolution, nominal timetable, and nominal passenger transport capacity, a measure for adapting the transport capacity of the transport line to said future temporal evolution;

the system (1) being further configured for applying said measure to the transport line (L1-L3), wherein said measure is:

- adding a transport vehicle to the line if, in said future temporal evolution, said number of passengers exceeds a first predefined threshold for a first given period of time; or
- withdrawing a vehicle from the line if, in said future temporal evolution, the number of passengers is smaller than a second given threshold for a second given period of time; or
- otherwise maintaining the transport capacity defined by the nominal timetable.

2. System (1) according to claim 1, wherein said number of passengers of the transport line (L1-L3) is the number of passengers of one of its components – called hereafter first component -, said components comprising at least the vehicles (V1-V12), the stations (S1-S15), and the platforms of the stations (S1-S15).

3. System (1) according to claim 2, wherein the processing unit (13) is configured for receiving or acquiring or generating, for said first component, a first set of data, wherein said first set of data comprises said number of passengers in function of the time, i.e. a temporal evolution of the number of passengers for said first component, said temporal evolution taking place within a first period of time, the processing unit (13) being configured for using said first set as input to the trained function, the latter being configured for outputting a first outputted set of data, wherein the

first outputted set of data defines, for said first component, the future temporal evolution of its number of passengers.

4. System (1) according to claim 2 or 3, wherein the main evaluation unit (10) is configured for automatically determining, in function of the time, the number of passengers of another component – called hereafter the second component - of the transport line (L1-L3).

5. System (1) according to claim 4, wherein the processing unit (13) is configured for receiving or acquiring or generating, for said second component, a second set of data, wherein said second set of data comprises said number of passengers in function of the time, i.e. a temporal evolution of the number of passengers for said second component, said temporal evolution taking place within said first period of time, the processing unit (13) being configured for using said second set of data together with said first set of data as input to the trained function, the latter being configured for outputting, in addition to the first outputted set, a second outputted set of data, wherein the second outputted set of data defines, for said second component, the future temporal evolution of its number of passengers.

6. System (1) according to claim 5, wherein the processing unit (13) is configured for automatically determining, from

- the future temporal evolution of the number of passengers of the first component,
- the future temporal evolution of the number of passengers of the second component,

- the nominal timetable, and
- the nominal passenger transport capacity,

said measure for adapting the transport capacity of the line to said future temporal evolutions of the first and second components.

7. System (1) according to claim 2 to 6, wherein the processing unit (13) is configured for acquiring at least one of the following additional data and using at least one of the acquired additional data for determining said measure:
- a threshold defining a maximum number of passengers for a component of the line; and/or
- a maximum difference defined between a flow of passenger arriving at a platform and a flow of passenger leaving said platform via vehicles stopping at said platform; and/or,
- a threshold configured for defining an oversized transport capacity for the line with respect to a demand.

8. System (1) according to one of the claims 1 to 7, wherein the main evaluation unit (10) comprises a VTCE unit (11) configured for determining, in function of the time, the number of passenger on-board a transport vehicle (V1-V12) of the transport line (L1-L3).

9. System (1) according to one of the claims 1 to 8, wherein the main evaluation unit (10) comprises a PPNE unit (12) configured for determining, in function of the time, the number of passengers waiting for a transport vehicle (V1-V12) at a platform and/or the number of passengers going to said platform.

10. System (1) according to one of the claims 1 to 9, wherein the trained function further uses as input at least one of the following data:
- a forecasted weather information; and/or
- a traffic information; and/or
- a forecasted event information; and/or
- holidays information.

11. System (1) according to one of the claims 1 to 10, wherein the processing unit (13) comprises a TCA algorithm configured for automatically generating an updated timetable comprising said measure.

12. System (1) according to one of the claims 1 to 11, wherein the processing unit (13) is further configured for determining from said future temporal evolution:
- one or several predictive KPIs among
    o a predicted vehicle occupancy in function of the time for said future temporal evolution if said measure is not applied; and/or
    o a predicted platform and/or station and/or line passenger occupancy in function of the time for said future temporal evolution if said measure is not applied; and/or
    o a predicted average waiting time, defined in function of the time, for passengers who will wait for a next incoming vehicle at a platform according to said future temporal evolution if said measure is not applied;
    o a predicted total waiting time if said measure is not applied;
    and/or

- one or several optimized KPIs among
    - o said predicted vehicle occupancy in function of the time for said future temporal evolution if said measure is applied; and/or
    - o said predicted platform and/or station and/or line passenger occupancy in function of the time for said future temporal evolution if said measure is applied; and/or
    - o a predicted average waiting time, defined in function of the time, for passengers who will wait for a next incoming vehicle at a platform according to said future temporal evolution if said measure is applied;
    - o a predicted total waiting time if said measure is applied;
    - and/or
- an optimized timetable comprising the applied measure; and/or
- for sending a passenger congestion warning.

13. A method for providing a trained function configured for predicting a future temporal evolution of a number of passengers of a transport line (L1-L3), said transport line comprising at least two stations (S1-S15), each station (S1-S15) comprising at least one platform served by transport vehicles (V1-V12), said stations, platforms, and vehicles being components of the transport line (L1-L3), the method comprising:
- receiving, via a first interface, input training data, wherein said input training data comprises
    - passenger numbers in function of the time for one or several of said components of the transport line, wherein for each of said component, the number of passengers in function of the time

defines a temporal evolution of said number of passengers during a first period of time;

- optionally, a set of timetables;

- receiving, via a second interface, output training data, wherein the output training data comprises:

- for each of said one or several components of the line for which said numbers of passengers in function of the time has been received as training input, a future temporal evolution of said numbers of passengers, wherein said future temporal evolution takes place in a second period of time, temporally consecutive to the first period of time;

- training a function based on the input training data and output training data with a training computation unit;

- providing, via a third interface, the trained function to a processing unit (13) of a system (1) for dynamically adapting a passenger transport capacity of a transport line according to one of the claims 1 to 12.

14. Method for dynamically adapting a passenger transport capacity of a transport line (L1-L3) to a number of passengers, said transport line (L1-L3) comprising at least two stations (S1-S15), each station (S1-S15) comprising at least one platform served by transport vehicles (V1-V12) of the transport line, said method comprising the steps:

- determining (201)a temporal evolution of a number of passengers for the transport line (L1-L3);

- receiving (202), by a processing unit (13), the following input data:

- said temporal evolution of the number of passengers;
- a nominal timetable defining the serving of said platforms of the line (L1-L3) by said transport vehicles (V1-V12);
- a nominal passenger transport capacity of each vehicle (V1-V12) of the line that can serve said platforms;

- applying (203), by the processing unit (13), a trained function to said temporal evolution of the number of passengers, wherein said trained function has been trained by a machine learning algorithm for automatically predicting a future temporal evolution of said number of passengers, and determining, by the processing unit (13) from said future temporal evolution, nominal timetable and nominal passenger transport capacity, a measure for adapting the transport capacity of the line (L1-L3) to said future temporal evolution;
- applying (204) said measure to the transport line

wherein said measure comprises:

- adding a transport vehicle to the line if, in said future temporal evolution, said number of passengers exceeds a first predefined threshold for a first given period of time; or
- withdrawing a vehicle from the line if, in said future temporal evolution, the number of passengers is smaller than a second given threshold for a second given period of time; or
- otherwise maintaining the transport capacity de-fined by the nominal timetable.