National Airspace Trajectory-Prediction System(NATS)

Gate to Gate Flight Plan Generator

Description
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This Python module generates Gate to Gate flight plans for entries in a given FAA flight plan TRX file. For each of the flight plans scanned by NATS, an augmented replacement is created and saved. FAA flight plans (SWIM) can be categorized into one of the following categories:

1. Flights on the Ground:
For these flights, the augmented flight plan generation requires the user to specify the following details:
1. Departure Airport Gate (Format: TERMINAL/CONCOURSE_GATE)
2. Departure Airport Runway (Format: RW___)
3. Arrival Airport Gate (Format: TERMINAL/CONCOURSE_GATE)
4. Arrival Airport Runway (Format: RW___)
5. Approach Procedure (Format given in list of choices by the program)

The augmented flight plan consists of the following sections fused together:
1. Departure Ground Taxi: This includes the flight first being at the gate, pushback to the ramp, taxi to the runway, and getting to the runway threshold.
2. Departure Procedures: Once the flight has reached the runway threshold, it executes a takeoff roll down the runway and begins climb. Continuing at the runway heading, the flight reaches a point to turn to the first calculated SID (Standard Instrument Departure) procedure waypoint. The last point on the SID marks the transition from initial climb to flight level 180 through the transition airspace.
3. Flight En Route: This consists of waypoints between climb and descent procedures. The waypoints that the flight needs to go through in cruise is defined by the en route flight plan.
4. Arrival Procedures: The calculated STAR (Standard Terminal Arrival Route) procedure waypoints are added to the flight plan. It directs the flight from the en route section towards final approach.
5. Arrival Ground Taxi: Finally, the taxi route from runway exit to the ramp for the assigned gate is appended to the flight plan.

2. Flights in Cruise:
For these flights, the augmented flight plan consists of the next waypoint from the current aircraft position together with the arrival procedures to the gate at the destination airport.

The user must provide the following inputs for every flight:
1. Arrival Gate at the Destination Airport (Format: TERMINAL/CONCOURSE_GATE)
2. Arrival Runway at the Destination Airport (Format: RW___)
3. Approach Procedure (Format given in list of choices by the program)

The augmented flight plan consists of the following sections fused together:
1. En Route Flight Plan: This consists of the route from upcoming waypoint till the beginning of the arrival procedures. The waypoints that the flight needs to go through along the flight trajectory are defined by the flight en route plan.
2. Arrival Procedures: Calculated STAR (Standard Terminal Arrival Route) procedure waypoints are added to the flight plan. It directs the flight from the en route portion of the flight plan to the final approach phase.

3. Arrival Ground Taxi: Once the aircraft has reached the runway exit, the taxi route will take the aircraft to the ramp area for the assigned gate. In both the cases, the new flight plan entry is created, and stored as a new TRX file with the naming syntax as NATS_Server/share/FlightPlanData/FlightPlans/TIMESTAMP_updated_trx.trx. These flight plans can then be used for trajectory prediction using NATS.

Software Requirements
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1. Linux 64bit Operating System
NATS software has been tested on:
Ubuntu v12.04, v16.04 with gcc 4.8
CentOS 6.9 with gcc 4.4
CentOS 7 with gcc 4.8
2. Java 1.7 and later
3. Jpype(For Python codes)
Tested on v0.6.0
To install Jpype 0.6.0
Go to https://github.com/originell/jpype
Download jpype-0.6.0.tar.gzUnzip it, enter the directory and execute commands.
sudo python setup.py install
5. Python 2.7
6. NATS Server Installation

Running sample programs
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Steps for usage in Python:
1. Run NATS Server by executing './run' under the NATS_Server
directory.
2. Change directory (Command cd) to NATS_Client.
3. Change NATS_SERVER (line 61) to the local path to NATS Server.
4. Change line 71 to update (if needed) the source TRX to be read
into NATS.
4. Open GateToGateFp.py, scroll to last line of code, and enter
the location of FAA TRX file to be augmented in the method call.
5. Run 'python GateToGateFp.py', and enter the inputs asked for
runways and gates.
6. Program will run and save the augmented TRX file.

Example Program Run
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hariiyer@XPS-8930:~/eclipse/workspace/1703/trunk/NATS_Client$ python sample/GateToGateFp.py
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  National Airspace Trajectory-Prediction System(NATS) Client
  Version: beta 1.3

  Optimal Synthesis Inc.
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Connected to NATS Server (localhost:2017)
Flight: SWA1897

Please provide departure gate at
KSFO[A_006,A_008,A_010,A_012,A_11A,A_011,A_009,A_007,A_005,B_020,B_022,B_24A,B_24
B,B_039,B_36B,B_36A,B_035,B_034,B_038,B_037,B_033,B_032A,B_32BC,B_025,B_031,B_021,C
_040,C_042,C_044,C_046,C_048,C_047,C_045,C_043,D_050,D_51A,D_51B,D_052,D_053,D_54A,
D_54B,D_055,D_56A,D_56B,D_057,D_58A,E_060,E_061,E_062,E_063,E_064,E_065,E_066,E_067,
E_068,05_010,01_070,01_071,06_003,06_004,06_005,F_77A,F_077,F_078,F_079,F_080,F_082,F_08
4,F_086,F_088,06_017,F_087,F_87A,F_085,F_083,F_081,01_072,01_73A,01_073,01_074,01_075,G
_92A,G_092,G_094,G_098,G_096,G_100,G_102,G_101,G_099,G_097,G_095,G_093,G_091,01_002,
01_001,02_001,03_001,03_002,03_004,03_003,04_001,04_002,05_001,06_001,06_002,06_003,06_00
4,07_001,07_002,07_003,07_004,07_005,07_006,07_007,08_001,C_041]: A_006
Please provide departure runway at KSFO[RW01R,RW01L,RW28R,RW28L]: RW28R

Please provide arrival gate at
KPHX[11_001,04_B15,04_B17,04_B19,04_B21,04_B23,04_B25,04_B27,04_B28,04_B26,04_B24,04
_B22,04_B20,04_B18,04_B16,04_0B1,04_0B3,04_0B5,04_0B7,04_0B9,04_B11,04_B13,04_B12,04_
B10,04_0B8,04_0B6,04_0B4,04_0B2,04_0A1,04_0A3,04_0A5,04_0A7,04_0A9,04_A11,04_A13,04_
A14,04_A12,04_A10,04_0A8,04_0A6,04_0A4,04_0A2,04_A15,04_A17,04_A19,04_A21,04_A23,04
_A25,04_A27,04_A29,04_A30,04_A28,04_A26,04_A22,04_A20,04_A18,03_015,03_017,03_019,03_
023,03_025,03_026,03_024,03_020,03_018,02_009,02_007,02_005,02_003,02_001,02_010,02_008,0
2_006,02_004,13_001,14_001,14_002,04_0D1,04_0D3,04_0D5,04_0D7,04_0D8,04_0D6,04_0D4,04
_0D2,04_0C1,04_0C3,04_0C5,04_0C7,04_0C8,04_0C6,04_0C4,04_0C2,04_C11,04_C13,04_C15,04_
C17,04_C18,04_C16,04_C14,04_C12,15_001,15_002,15_003,16_001,16_002,17_001,02_002,04_B14
]: 11_001
Please provide arrival runway at KPHX[RW25L,RW26]: RW26

Please select approach procedure for arrival into KPHX[H07LZ,H07RZ,H08-Z,H25LZ,H25RZ,H26-
Z,I07L,I07R,I08,I25L,I26,L07L,L07R,L08,L25L,L26,R07LY,R07RY,R08-Y,R25LY,R25RY,R26-Y]:
R26-Y
Flight Plan Saved for SWA1897

Gate To Gate Flight Plan:

TRACK_TIME 1121238067
TRACK SWA1897 B733 373638 1222286 130 0 28 ZOA ZOA46
  FP_ROUTE KSFO.<{"id": "Gate_A_006"}, {"id": "Ramp_01_001"}, {"id": "Ramp_01_002"}, {"id": "Ramp_01_003"}, {"id": "Ramp_01_004"}, {"id": "Ramp_01_005"}, {"id": "Ramp_01_006"}, {"id": "Ramp_01_007"}, {"id": "Txy_M_H"}, {"id": "Txy_H_001"}, {"id": "Txy_H_002"}, {"id": "Txy_H_003"}, {"id": "Txy_H_004"}, {"id": "Txy_H_005"}, {"id": "Txy_H_006"}, {"id": "Txy_A_004"}, {"id": "Txy_A_H"}, {"id": "Txy_B_H"}, {"id": "Txy_H_007"}, {"id": "Rwy_01_002"}, {"id": "Txy_H_008"}, {"id": "Txy_H_009"}, {"id": "Rwy_02_004"}, {"id": "Txy_G_005"}, {"id": "Txy_L_004"}, {"id": "Txy_L_005"}, {"id": "Txy_F_005"}, {"id": "Txy_F_N"}, {"id": "Txy_F_004"}, {"id": "Txy_F_003"}, {"id": "Txy_F_002"}, {"id": "Txy_F_001"}, {"id": "Rwy_03_001"}, {"id": "Txy_C_001"}, {"id": "Txy_C_002"}, {"id": "Rwy_04_001"}>.RW28R.WESLA3.LOSHN..BOILE..BLH.ARLIN4.R26-Y.RW26.<{"id": "Rwy_01_003"}, {"id": "Txy_B3_001"}, {"id": "Txy_B_003"}, {"id": "Txy_B_004"}, {"id": "Txy_B_005"}, {"id": "Txy_B_006"}, {"id": "Txy_B_007"}, {"id": "Txy_B_008"}, {"id": "Txy_B_009"}, {"id": "Txy_B_010"}, {"id": "Txy_B_011"}, {"id": "Txy_B_012"}, {"id": "Txy_B_013"}, {"id": "Txy_B_014"}, {"id": "Txy_C_011"}, {"id": "Txy_C_012"}, {"id": "Ramp_03_007"}, {"id": "Ramp_03_006"}, {"id": "Txy_C_013"}, {"id": "Txy_C_014"}, {"id": "Ramp_02_007"}, {"id": "Ramp_02_006"}, {"id": "Txy_C_016"}, {"id": "Ramp_01_005"}, {"id": "Ramp_01_004"}, {"id": "Txy_C_017"}, {"id": "Txy_R_001"}, {"id": "Txy_R_002"}, {"id": "Ramp_11_002"}, {"id": "Parking_11_001"}>.KPHX