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:

- Departure Airport Gate (Format: TERMINAL/CONCOURSE_GATE)
- Departure Airport Runway (Format: RW___)
- Arrival Airport Gate (Format: TERMINAL/CONCOURSE_GATE)
- Arrival Airport Runway (Format: RW___)
- SID procedure at departure airport.
- Enroute waypoints.
- STAR procedure at arrival airport.
- Approach Procedure for landing.

The augmented flight plan consists of the following sections fused together:

- 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.
- Departure Runway
- 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.
- 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.
- 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.
- Arrival Runway
- 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.

For these flights, the augmented flight plan generation requires the user to specify the following details:

- Arrival Airport Gate (Format: TERMINAL/CONCOURSE_GATE)
- Arrival Airport Runway (Format: RW___)
- Enroute waypoints.
- STAR procedure at arrival airport.
- Approach Procedure for landing.

The augmented flight plan consists of the following sections fused together:

- 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.
- 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.
- Arrival Runway
- 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 cases, the new flight plan entry is created, and the new flight plan is given out as output. This updated flight plan FP_ROUTE can be used as per requirement in TRX records for simulation.

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. Specify the TRX and MFL files as the input of
    aircraftInterface.load_aircraft(filename_trx, filename_mfl) function.
4. Run 'python GateToGateFp.py', and enter the inputs asked for runways, gates, and other information.
6. Program will run and display the augmented FP_ROUTE data.

Example Program Run
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~/NATS_Client$ python sample/GateToGateFp_beta1.x.py
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National Airspace Trajectory-Prediction System(NATS) Client
Version: beta 1.x

Optimal Synthesis Inc.
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Connected to NATS Server (localhost:2017)
Augmented flight plan generation for aircraft: SWA732

Has the aircraft already taken off? (Please answer yes/no): no

Please choose a departure gate at KLAS among
[Gate_01_A08,Gate_01_A09,Gate_01_A10,Gate_01_A11,Gate_01_A12,Gate_01_A13,Gate_01_A14,
Gate_01_A15,Gate_01_A16,Gate_01_A17,Gate_01_A18,Gate_01_A19,Gate_01_A20,Gate_01_A21,
Gate_01_A22,Gate_01_B01,Gate_01_B02,Gate_01_B05,Gate_01_B09,Gate_01_B10,Gate_01_B11,G
ate_01_B12,Gate_01_B13,Gate_01_B14,Gate_01_B15,Gate_01_B17,Gate_01_B18,Gate_01_B19,Gat
e_01_B20,Gate_01_B21,Gate_01_B22,Gate_01_B23,Gate_01_B24,Gate_01_B25,Gate_01_C01,Gate
_01_C02,Gate_01_C04,Gate_01_C05,Gate_01_C07,Gate_01_C08,Gate_01_C09,Gate_01_C11,Gate_
01_C13,Gate_01_C14,Gate_01_C16,Gate_01_C18,Gate_01_C19,Gate_01_C21,Gate_01_C22,Gate_0
1_C23,Gate_01_C24,Gate_01_C25,Gate_01_C27,Gate_01_D01,Gate_01_D02,Gate_01_D03,Gate_01
_D04,Gate_01_D05,Gate_01_D06,Gate_01_D07,Gate_01_D08,Gate_01_D09,Gate_01_D10,Gate_01_
D11,Gate_01_D12,Gate_01_D13,Gate_01_D16,Gate_01_D17,Gate_01_D18,Gate_01_D19,Gate_01_
D20,Gate_01_D21,Gate_01_D22,Gate_01_D23,Gate_01_D24,Gate_01_D25,Gate_01_D32,Gate_01_
D33,Gate_01_D34,Gate_01_D35,Gate_01_D36,Gate_01_D37,Gate_01_D38,Gate_01_D39,Gate_01_
D40,Gate_01_D41,Gate_01_D42,Gate_01_D43,Gate_02_001,Gate_02_002,Gate_02_003,Gate_02_00
4,Gate_02_005,Gate_02_006,Gate_02_007,Gate_02_008,Gate_03_001,Gate_03_002,Gate_03_003,Ga
te_03_004,Gate_terminalA_023,Parking_01_080,Parking_01_081,Parking_01_082,Parking_01_083,P
arking_01_084,Parking_01_085,Parking_01_086,Parking_01_099,Parking_01_100,Parking_01_101,P
arking_01_102,Parking_01_103,Parking_01_D01,Parking_01_D02,Parking_01_D03,Parking_01_D04,
Parking_01_D05,Parking_01_D06,Parking_01_D07,Parking_01_D08,Parking_01_D09,Parking_01_D
10,Parking_01_D11,Parking_01_D12,Parking_01_D13,Parking_01_D14,Parking_01_D15,Parking_01
_D16,Parking_01_D17,Parking_01_D18,Parking_01_D19,Parking_01_D20,Parking_01_D21,Parking_

01_D22,Parking_01_D23,Parking_01_D24,Parking_01_D25,Parking_01_D26,Parking_01_D27,Parking_01_D28,Parking_01_D29,Parking_01_D30,Parking_01_D31,Parking_01_D32,Parking_01_D33,Parking_01_D34,Parking_01_D35,Parking_01_D36,Parking_02_001,Parking_H1_001,Parking_H2_001,Parking_H2_002,Parking_H_001,Parking_H_002,Parking_H_003,Parking_H_004,Parking_H_006,Parking_H_007,Parking_H_008,Parking_H_010,Parking_Helipad_H1_001,Parking_Helipad_H1_002,Parking_Helipad_H1_003,Parking_Helipad_H5_001,Parking_Helipad_H_001,Parking_Helipad_H_002,Parking_Helipad_H_003,Parking_Helipad_H_004,Parking_Helipad_H_005,Parking_Helipad_H_006,Parking_Helipad_H_007,Parking_Helipad_H_008,Parking_Helipad_H_009,Parking_Helipad_H_010,Parking_Helipad_H_011,Parking_Helipad_H_012,Parking_Helipad_H_033,Parking_Helipad_H_044,Parking_Helipad_H_055,Parking_Helipad_H_077,Parking_M1_001,Parking_M1_002,Parking_M1_003,Parking_M1_004,Parking_M1_005,Parking_M1_006,Parking_M1_007,Parking_M_001,Parking_M_002,Parking_M_003,Parking_M_004,Parking_M_005,Parking_M_006,Parking_M_007,Parking_M_008]: Gate_01_A08

Please choose a departure runway at KLAS among [RW19L,RW26L,RW08L,RW01R,RW01L,RW08R,RW26R,RW19R]: RW19L

Please choose an arrival gate at KLAX among [Gate_01_009,Gate_01_010,Gate_01_013,Gate_01_015,Gate_01_11A,Gate_01_11B,Gate_01_12A,Gate_01_16A,Gate_01_17A,Gate_01_17B,Gate_02_021,Gate_02_022,Gate_02_023,Gate_02_024,Gate_02_025,Gate_02_026,Gate_02_027,Gate_02_21B,Gate_02_23A,Gate_02_24A,Gate_03_030,Gate_03_032,Gate_03_034,Gate_03_035,Gate_03_036,Gate_03_038,Gate_03_039,Gate_03_31A,Gate_03_31B,Gate_03_33A,Gate_03_33B,Gate_03_37A,Gate_03_37B,Gate_04_041,Gate_04_042,Gate_04_043,Gate_04_044,Gate_04_045,Gate_04_046,Gate_04_46B,Gate_04_47A,Gate_04_47B,Gate_04_48A,Gate_04_48B,Gate_04_49A,Gate_04_49B,Gate_05_052,Gate_05_056,Gate_05_057,Gate_05_059,Gate_05_50A,Gate_05_50B,Gate_05_51A,Gate_05_51B,Gate_05_53A,Gate_05_53B,Gate_05_54A,Gate_05_54B,Gate_05_55A,Gate_06_060,Gate_06_061,Gate_06_062,Gate_06_063,Gate_06_064,Gate_06_066,Gate_06_067,Gate_06_65A,Gate_06_65B,Gate_06_68A,Gate_06_68B,Gate_06_69A,Gate_06_69B,Gate_07_072,Gate_07_073,Gate_07_074,Gate_07_076,Gate_07_70A,Gate_07_70B,Gate_07_71A,Gate_07_71B,Gate_07_75A,Gate_07_75B,Gate_07_77B,Gate_08_081,Gate_08_083,Gate_08_084,Gate_08_085,Gate_08_086,Gate_08_087,Gate_08_088,Gate_11_001,Gate_11_002,Gate_11_003,Gate_11_004,Gate_11_005,Gate_11_006,Gate_11_007,Gate_11_008,Gate_11_009,Gate_11_010,Gate_11_011,Gate_11_012,Gate_11_013,Gate_11_014,Gate_11_015,Gate_11_016,Gate_11_017,Gate_11_018,Gate_11_019,Gate_I_123,Gate_I_131,Gate_I_132,Gate_I_133,Gate_I_134,Gate_I_148,Gate_I_150,Gate_I_151,Gate_I_152,Gate_I_153,Gate_I_154,Gate_I_155,Gate_I_156,Gate_I_157,Parking_A1_001,Parking_A2_001,Parking_A3_001,Parking_A3_002,Parking_A3_003,Parking_A4_001,Parking_A5_001,Parking_A5_002,Parking_A6_001,Parking_AG_001,Parking_AG_002,Parking_AG_003,Parking_AG_004,Parking_AG_005,Parking_AG_006,Parking_AG_007,Parking_B1_001,Parking_C14_001,Parking_C15_001,Parking_C17_001,Parking_C18_001,Parking_C1_001,Parking_C2_001,Parking_C3_001,Parking_C4_001,Parking_C5_001,Parking_E11_001,Parking_E12_001,Parking_E13_001,Parking_E14_001]: Gate_01_009

Please choose an arrival runway at KLAX among [RW24R,RW07L,RW06L,RW25R,RW06R,RW25L,RW24L,RW07R]: RW24R

Please choose a SID procedure for departure from KLAS among [BOACH8,COWBY8,HOOVR6,LAS5,MCCRN5,PRFUM4,SHEAD1,STAAV8,TRALR9]: BOACH8

Please enter enroute waypoints in flight plan separated by ',' (Eg. BOILE,LOSHN,BLH): WHIGG,OTOOL

Please choose a STAR procedure for arrival into KLAX among [ANJLL4,BASET5,BAYST1,BIGBR3,BOGET2,BRUEN2,DIRBY1,DOWNE4,GOATZ1,HLYWD1,HUULL2,IRNMN2,KIMMO3,LEENA7,MDNYT2,MOOR4,OCEAN3,OLAAA1,RYDRR2,SADDE8,SEAVU2,SHIVE1,SNSTT2,VISTA3,WAYVE1,ZUUMA2]: ANJLL4

Please choose an Approach procedure for arrival into KLAX among [H06LZ,H06RZ,H07LZ,H07RZ,H24LZ,H24RZ,H25LZ,H25RZ,I06L,I06R,I07L,I07R,I24L,I24R,I25L,I25R,L06L,L06R,L07L,L07R,L24L,L24R,L25L,L25R,R06LY,R06RY,R07LY,R07RY,R24LY,R24RY,R25LY,R25RY]: I24R

The augmented flight plan for flight SWA732 is as follows. FP_ROUTE value in the original TRX can be replaced by this flight plan.

KLAS.<{"id": "Gate_01_A12"}, {"id": "Ramp_01_016"}, {"id": "Ramp_01_020"}, {"id": "Ramp_01_021"}, {"id": "Ramp_01_022"}, {"id": "Txy_G5_001"}, {"id": "Ramp_01_023"}, {"id": "Ramp_01_024"}, {"id": "Ramp_01_026"}, {"id": "Txy_S_D"}, {"id": "Ramp_02_032"}, {"id": "Ramp_02_033"}, {"id": "Ramp_02_034"}, {"id": "Ramp_02_037"}, {"id": "Ramp_02_035"}, {"id": "Txy_D_N"}, {"id": "Txy_D_M"}, {"id": "Txy_D_L"}, {"id": "Txy_L_001"}, {"id": "Rwy_2_004"}>.RW19L.BOACH8.WHIGG..OTOOL.ANJLL4.I24R.RW24R.<{"id": "Rwy_04_005"}, {"id": "Txy_BB_003"}, {"id": "Txy_BB_002"}, {"id": "Rwy_03_009"}, {"id": "Txy_BB_001"}, {"id": "Txy_E_BB"}, {"id": "Txy_E_AA"}, {"id": "Txy_E_Z"}, {"id": "Txy_E_E13"}, {"id": "Txy_E_E12"}, {"id": "Txy_E_E11"}, {"id": "Txy_E_S"}, {"id": "Txy_E_Q"}, {"id": "Txy_E_W"}, {"id": "Txy_E_E10"}, {"id": "Txy_E_D9"}, {"id": "Txy_E_E8"}, {"id": "Txy_E_D8"}, {"id": "Txy_E_001"}, {"id": "Txy_E_V"}, {"id": "Txy_E_D7"}, {"id": "Txy_D_D7"}, {"id": "Ramp_01_006"}, {"id": "Ramp_01_007"}, {"id": "Ramp_01_008"}, {"id": "Ramp_01_009"}, {"id": "Gate_01_009"}>.KLAX

NATSClient closed connection from server.
JVM has been shutdown

Finally, the program prints out the augmented info(above text in yellow background) of the FP_ROUTE which can be put in TRX file.