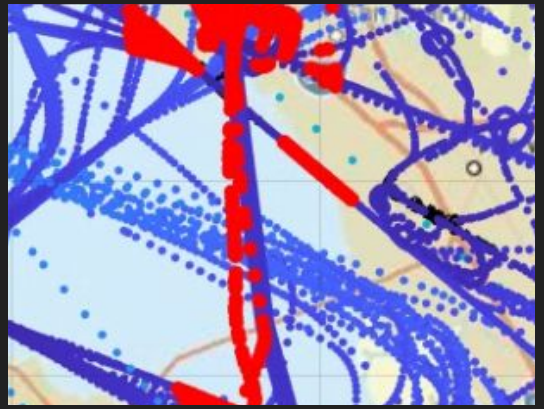
in Urban Air Mobility Design

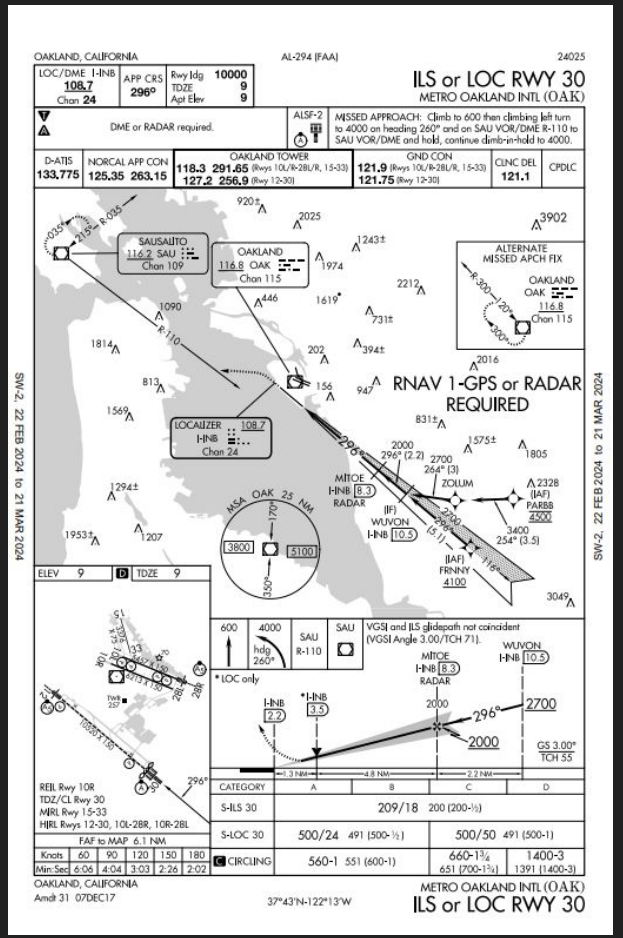
Alexander Aghili and the CITRIS Aviation Prize Team

CITRIS Aviation Prize

- Broad-Scope Project:
  - UC-wide competition on urban air mobility innovation
  - Students design eVTOL simulation and operations systems
  - Focus on interconnectivity, safety, and sustainable transport
  - Multiphase challenge: proposals, design, testing, and presentations
- Required Evaluation of Proposed UAM Systems. Using Scenic to:
  - Easily create and test different UAM scenarios
  - Quickly collect and aggregate data from simulations
  - Advise on UAM challenges and federal regulations
- Used Scenic with Microsoft Flight Simulator

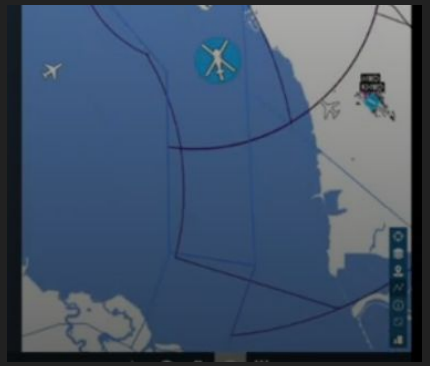

CLASS C
OAKLAND
ALAMEDA
SAN LEANDRO
HUNTERS POINT
SAN FRANCISCO
BAY SHOREVIEW TRANSITION ROUTE ATC CLEARANCE REQUIRED
OAKLAND INTL (OAK)
NO SVFR
SAN FRANCISCO INTL (SFO)
MID-SPAN SAN MATEO BRIDGE (VPMID)
SAN MATEO
HAYWARD EXEC (HWD)
CASTRO VALLEY
LAKE CHABOT (VPCBT)
ST. MARY'S
MORMON TEMPLE (VPMOR)
NEWARK

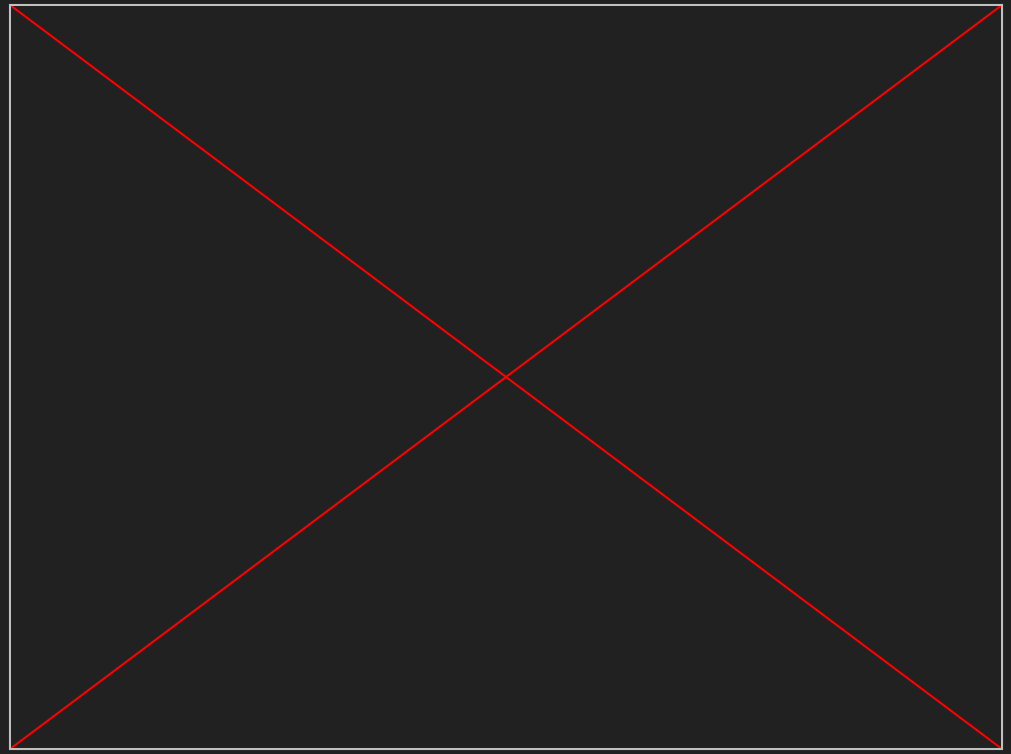



OAKLAND, CALIFORNIA
AL-294 (FAA)
24025
ILS or LOC RWY 30
METRO OAKLAND INTL (OAK)
LOC/DME I-INB 108.7 Chan 24
APP CRS 296°
Rwy Idg 10000
TDZE 9
Apt Elev 9
DME or RADAR required.
ALSF-2
MISSED APPROACH: Climb to 600 then climbing left turn to 4000 on heading 260° and on SAU VOR/DME R-110 to SAU VOR/DME and hold, continue climb-in-hold to 4000.
D-ATIS 133.775
NORCAL APP CON 125.35 263.15
OAKLAND TOWER 118.3 291.65 (Rwys 10L/R-28L/R, 15-33) 127.2 256.9 (Rwy 12-30)
GND CON 121.9 (Rwys 10L/R-28L/R, 15-33) 121.75 (Rwy 12-30)
CLNC DEL 121.1
CPDLC
SAUSALITO 116.2 SAU Chan 109
OAKLAND 116.8 OAK Chan 115
ALTERNATE MISSED APCH FIX
OAKLAND OAK 116.8 Chan 115
LOCALIZER 108.7 I-INB Chan 24
RNAV 1-GPS or RADAR REQUIRED
MITOE I-INB 8.3 RADAR
ZOLUM
PARBB 4500
WUVON I-INB 10.5
FRNNY 4100
MSA OAK 25 NM
3800
5100
ELEV 9
TDZE 9
VGSI and ILS glidepath not coincident (VGSI Angle 3.00/TCH 71).
* LOC only
GS 3.00° TCH 55
REIL Rwy 10R
TDZ/CL Rwy 30
MIRL Rwy 15-33
HIRL Rwys 12-30, 10L-28R, 10R-28L
FAF to MAP 6.1 NM
CATEGORY A B C D
S-ILS 30 209/18 200 (200-½)
S-LOC 30 500/24 491 (500-½) 500/50 491 (500-1)
C CIRCLING 560-1 551 (600-1) 660-1¾ 651 (700-1¾) 1400-3 1391 (1400-3)
Knots 60 90 120 150 180
Min:Sec 6:06 4:04 3:03 2:26 2:02
OAKLAND, CALIFORNIA
Amdt 31 07DEC17
37°43'N-122°13'W
METRO OAKLAND INTL (OAK)
ILS or LOC RWY 30
SW-2, 22 FEB 2024 to 21 MAR 2024
SW-2, 22 FEB 2024 to 21 MAR 2024

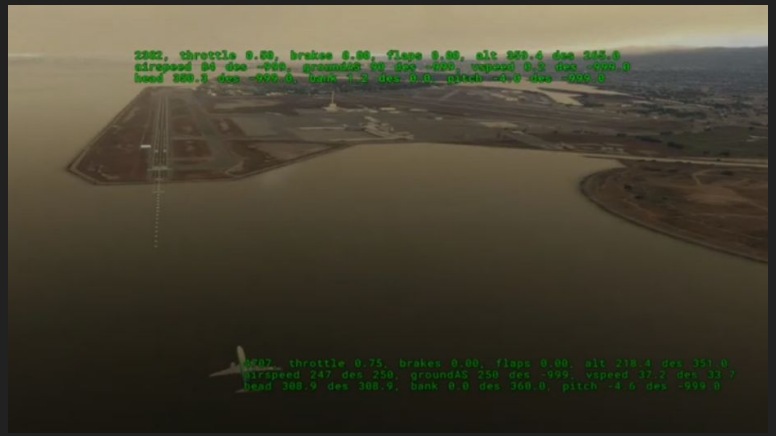
Scenic in Action

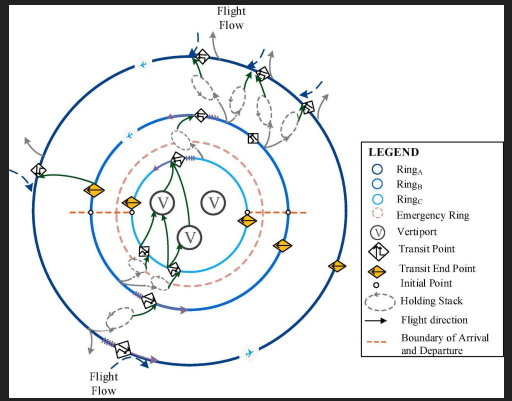
```
model scenic.simulators.msfs.model
import math

ego = new EgoAircraft at waypoint("VPMID", Range(800, 1400))

TYDYE = new Waypoint with waypoint_id "TYDYE", with alt 3000
TRUKN = new Waypoint with waypoint_id "TRUKN", with alt 5000, with speed 250

trukn2 = [TYDYE, TRUKN]

WUVON = new Waypoint with waypoint_id "WUVON", with alt 4100
MITOE = new Waypoint with waypoint_id "MITOE", with alt 2000, with speed 180
GO_AROUND = new Waypoint with lat 37.687960, with lon -122.192458, with alt 400
THREE_ZERO = new Waypoint with lat 37.702506, with lon -122.215325, with alt Range(800, 1400)

oak_30_arr = [WUVON, MITOE, GO_AROUND, THREE_ZERO]

a = new Plane737Max8Passengers at waypoint("FRNNY", 4100), with speed 210, with trajectory oak_30_arr
b = new Plane737Max8Passengers at spatial_position_to_euclidian(37.608353, -122.379887, 0), with trajectory trukn2, with ground 1
```

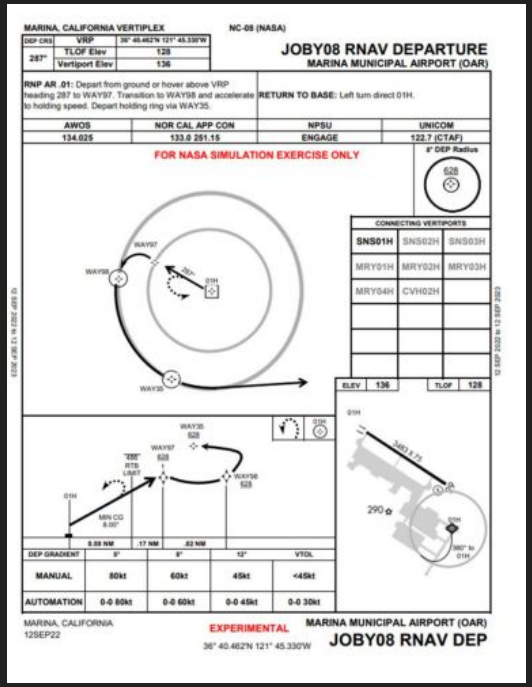




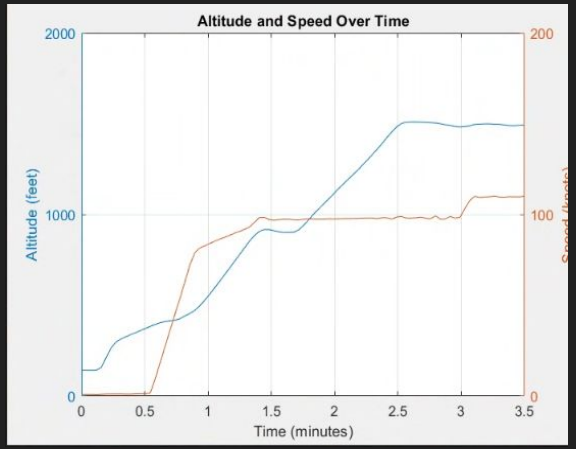

AIRSPEED
110
100
FUEL

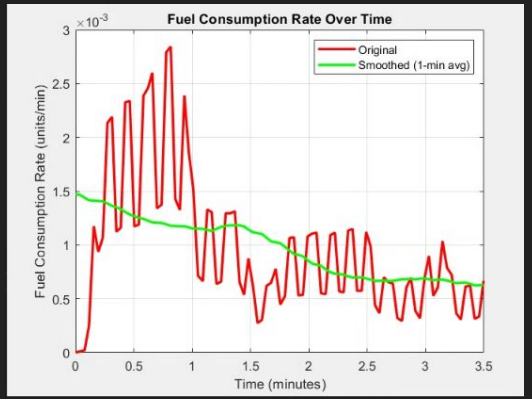



Flight Flow
Flight Flow
LEGEND
Ring$_A$
Ring$_B$
Ring$_C$
Emergency Ring
Vertiport
Transit Point
Transit End Point
Initial Point
Holding Stack
Flight direction
Boundary of Arrival and Departure


MARINA, CALIFORNIA VERTIPLEX
NC-08 (NASA)
JOBY08 RNAV DEPARTURE
MARINA MUNICIPAL AIRPORT (OAR)
FOR NASA SIMULATION EXERCISE ONLY
MANUAL
AUTOMATION
EXPERIMENTAL
MARINA MUNICIPAL AIRPORT (OAR)
JOBY08 RNAV DEP


Path of the Plane
36°42'N
36°41'N
36°40'N
Latitude
121°48'W
121°46'W
Longitude
1 km
0.5 mi
Earthstar Geographics


Altitude and Speed Over Time
Altitude (feet)
Time (minutes)


Fuel Consumption Rate Over Time
Original
Smoothed (1-min avg)
Fuel Consumption Rate (units/min)
Time (minutes)

Lessons

- Scenic is useful for data generation, control evaluation, and scenario creation.
  - Tested Procedures, Routes, and Warning System.
- Choose the simulator carefully
  - Sometimes, especially for complex scenarios, you may want to do weird things with a simulator that it isn’t expecting. MSFS, while useful for our prize work, likely wouldn’t succeed in more advanced projects due to limited control, hidden interfaces, and restricted documentation. Ideally, use a simulator with as much control as possible.
  - Requires upfront investment to build the simulator interface.

Future Work

- Move to X-Plane for greater control of the simulator and simulation environment
- Test specific components: TCAS, GPWS, other On-Board Automation Systems in UAM Environments

Thank You