

The Future of Flight



**An AI agentic system  
steering the aircraft**

**(Proof of Concept,  
Full autonomous or  
Copilot)**

Monthly EVTOL FTC meeting, Nov. the 4th 2025.

Powered by DSPy (Stanford)

# Big picture fits in minimal model

**Question** → can AI agents (born 2024) compete with humans on tasks carried out on a FAR25 flight? (Matter of PERFORMANCE, research domain)

**Answer** → **YES**, ap. from manual steering (possible, extra work, out of scope)

**Setup** → Likely & sensible: AI on top of critical software

Like FMS was built on top of FCC, AI will be on top of both.

Access to any other critical or secondary system onboard is expected.

Are all data accessible in prototyping phase? Certification phase?

**Proof** → simulate data + actions needed for a CPL/ATPL pilot to fulfill an IFR mission (min. expressive model)

– cognitive- (respect of FMS targets, pilot's cmds)

– cognitive+ (briefings, compliance... → **eg. diversion**)

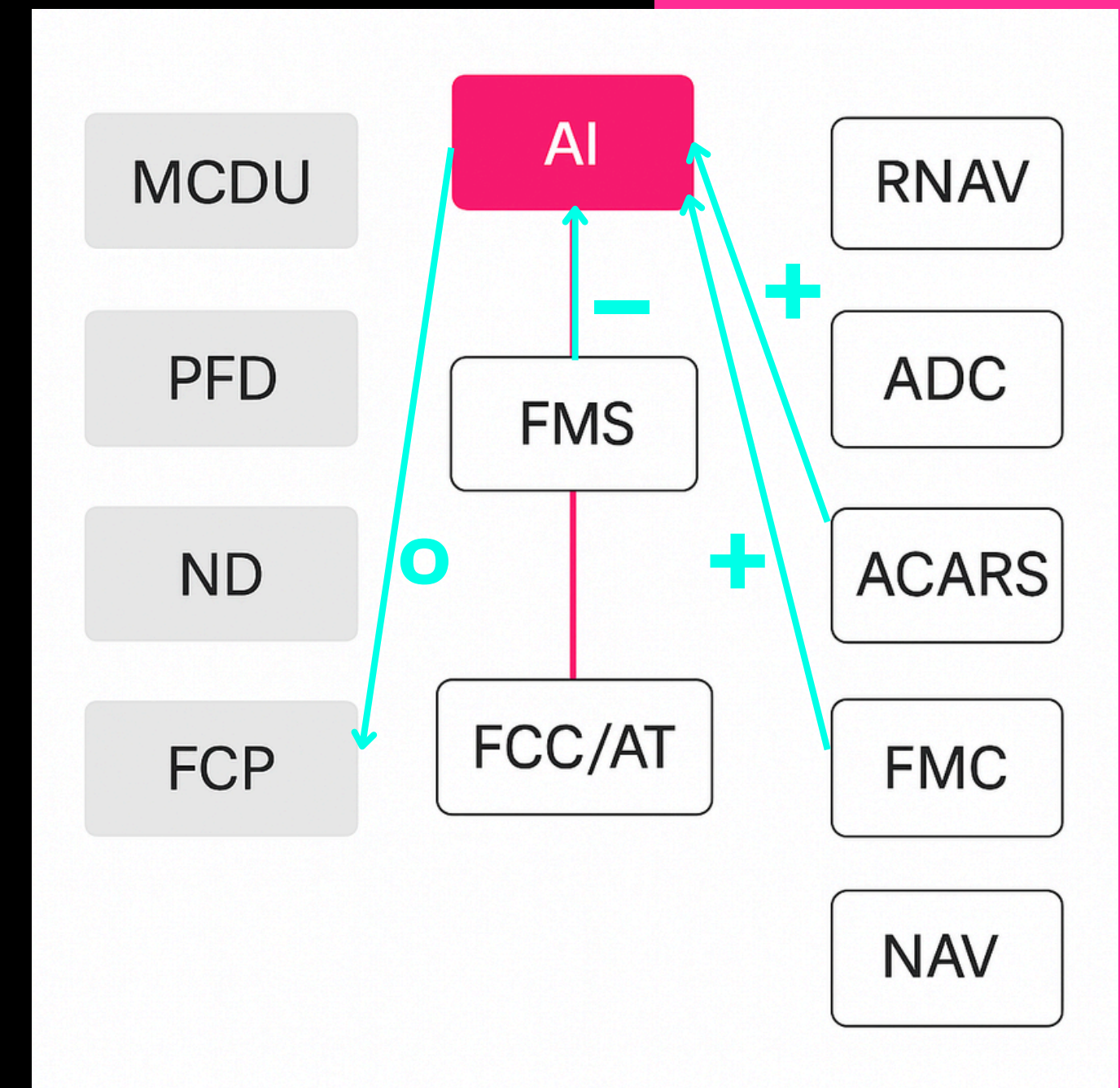
– actions $\circ$ : via FCP (if pilot on board setup) or digital bus

**Cognitive+**

– MEL/HIL, notams, weather, analysis of some sort to compute the 7-8 limitations and the limitation of the day, the min fuel and reserve, the payload and extra load...

Everything needed for a FAR/JAR25 **DEPARTURE BRIEFING** (CPL/IR exam).

– The design proposes an original **SITUATION AWARENESS** summary.



# Minimal model here means 2D...

We did not code a fancy simulator nor did we code the 'air' environment. The expressiveness of a 2D model is enough to convince

The model uses a FMS like event/clock-based queue that POPs events solely based on time. This is 2D for time+nature of the event.

We don't simulate ALTITUDE data or L/NAV details or the air/surface environment. Any other input from other modules would be handled quite the same way (no extra complexity, any use case).

Eg, ADC data will be picked when needed (speed check → flaps).

Existing ML modules etc. will just connect to agents (orchestration layer).

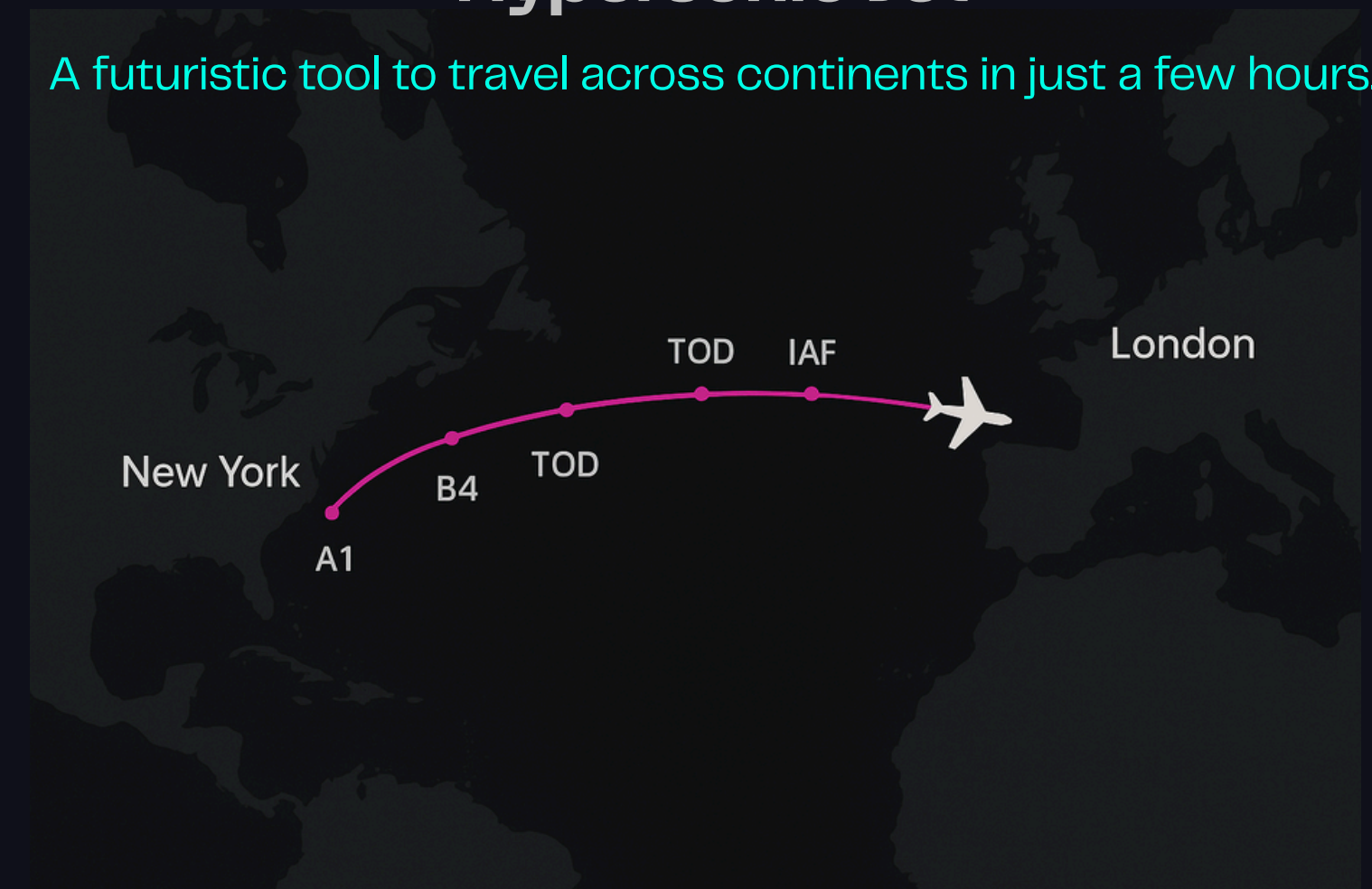
High-frequency: skipped, still managed by FCC command laws.

Model's FOCUS: issuing correct CMDs and higher-level mission updates from FMS / WX / FMC events (or human pilot's voice).



## Hypersonic Jet

A futuristic tool to travel across continents in just a few hours.



# ... and big means basic commands + cognitive tasks (1/3)

```
15:38:52: [15:39:01] AI: [Edition of MissionAgent registry]: We POP @0.4: **Vz positive Check -> Set LDG_GEAR UP**
15:39:01: [15:39:01] AI: [Edition of MissionAgent registry]: Next event: ZAC -> Check, 0.6
15:39:01: [15:39:04] AI: [Edition of PilotAgent registry]: {
  "situation": {
    "lf_picasso": {
      "FMC": "G",
      "DEST_WX": "G",
      "DEST_LD": "Y",
      "DEST_RG": "G",
      "DEST_PROC": "G",
      "ALTN_DEST_WX": "G",
      "ALTN_DEST_LD": "G",
      "ALTN_DEST_RG": "G",
      "ALTN_DEST_PROC": "G"
    },
    "lf_situation": "\"0 Red, 1 Yellow ( DEST_LD ), 8 Greens\"",
    "cmd_update_interpretation": "ONLY when the aircraft is actually climbing MUST the LDG_GEAR be retracted, OK"
  },
  "fcp": {
    "N1_SEL": "MAX_T0",
    "ALT_SEL": "11000",
    "PITCH": "10",
    "LDG_GEAR": "UP"
  },
  "cmds_1": {},
  "cmds_2": {}
}
```

'+ive climb → GEAR UP' pops : the agent takes action

As mentioned above, the actual check for positive climb will eventually come from the ADC, but checks emanate from FMS in our min. model. Notice the agent's interpretation!



Basic commands mean that when it's time for a popped action, **the expected command** is correctly passed to the FCP (or directly FCC) or relevant system

**Multi-crew rules apply: Tech announcement + Xcheck**  
– implicit or explicit ack. modes,  
– 3 seconds for a human captain, if any, to cancel the command .

Full autonomy will likely mean that the Xcheck is performed by another agent, the same way.

# ... and big means basic commands + cognitive tasks (2/3)



```
QRH - NORM CLIMB (CRJ1000) / Operational

LANDING GEAR Check -> UP

FLAPS Check -> 0

BOTH THRUST REVERSE switches -> OFF

END OF PROCEDURE
```

```
cmds_1 : 15,
"cmds_2": {}
}
21:52:53: [21:52:56] AI: [Edition of MissionAgent registry]: We POP @8.0: **LANDING GEAR Check -> UP**
21:52:56: [21:52:56] AI: [Edition of MissionAgent registry]: Next event: FLAPS Check -> 0, -298.0
21:52:56: [21:53:03] AI: [Edition of MissionAgent registry]: We POP @8.4: **FLAPS Check -> 0**
21:53:03: [21:53:03] AI: [Edition of MissionAgent registry]: Next event: BOTH THRUST REVERSE switches -> OFF, -297.0
21:53:03: [21:53:03] AI: [Edition of PilotAgent registry]: {
"situation": {
```

```
cmds_1 : 16,
}
21:53:03: [21:53:09] AI: [Edition of MissionAgent registry]: We POP @9.2: **BOTH THRUST REVERSE switches -> OFF**
21:53:09: [21:53:09] AI: [Edition of MissionAgent registry]: Next event: FL100 -> Set speed to 300kts, 5.0
21:53:09: [21:53:15] AI: [Edition of MissionAgent registry]: We POP @10.0: **FL100 -> Set speed to 300kts**
21:53:15: [21:53:15] AI: [Edition of MissionAgent registry]: Next event: procedure -> FL100 climb, 5.1
21:53:15: [21:53:15] AI: [Edition of PilotAgent registry]: {
```

## Procedure climb

Procedure is shown. If accepted, items are merged BACK into the FMS queue and popped.

Impl. detail: **gather all** expected actions during the flight **in the FMS** (w. priority queue, one of the most helpful data structures in algs, as for modern ATC optimal next solutions)

**We let all NORM / ABNORM / EMER procedures be merged into the event/clock queue-based FMS.**

**We benefit from a free priority ORDERING, a very desirable objective / rule, taught to pilots.**

**All items are ranked, eventually popped, atomic, and identifiable as technical announcements for Xcheck.**

# ... and big means basic commands + cognitive tasks (3/3)



Let's enroll briefings and post-failure analysis events in the queue!? These legacy human communication points are now supported/replaced by a permanently **updated SITUATION AWARENESS AI display (Picasso©)**

```
"DEST_APT_3": {
  "ID": "LFML",
  "RWY": "13R",
  "Altitude": "74ft",
  "Procedure": "ILS 13R",
  "MSA": "4200ft",
  "Minimas": "215ft",
  "NOTAMS": "",
  "Limits_LDG": {
    "RGA": "2.1%",
    "LDA": "2100m"
  },
  "Perfs_LDG": {
    "RG": "2.8%",
    "LD": "1700m"
  },
  "COLOR_LDG": {
    "LD": "YELLOW",
    "RG": "GREEN",
    "PROC": "GREEN"
  },
  "EXPLAIN_COLOR": {
    "LD": "LDA > LD, and diff. between LDA and LD (2100m-1700m) is LESS than company MARGIN for distances (500m), yielding YELLOW color",
    "RG": "RGA < RG, and diff. between RG and RGA is MORE than company MARGIN for climb gradients (0.5%), yielding GREEN color",
    "PROC": "Procedure is ILS CatI, precision approach, yielding a GREEN color."
  }
},
21:51:21: [21:51:21] AI: [Edition of PilotAgent registry]: {
  "situation": {
    "lf_picasso": {
      "FMC": "G",
      "DEST_WX": "G",
      "DEST_LD": "Y",
      "DEST_RG": "G",
      "DEST_PROC": "G",
      "ALTN_DEST_WX": "G",
      "ALTN_DEST_LD": "G",
      "ALTN_DEST_RG": "G",
      "ALTN_DEST_PROC": "G"
    },
    "lf_situation": "0 Red, 1 Yellow ( DEST_LD ), 8 Greens",
    "cmd_update_interpretation": ""
  },
  "fcp": {},
  "cmds_1": {},
  "cmds_2": {}
}
```

**An AI display YELLOW LD condition spotted @destination. Other key conditions are GREEN**

This LD YELLOW condition (convention  $LDA - LD < .500m$ , company margin, say) is computed/maintained by an agent and passed/displayed to the pilot (AI/human) throughout the flight (synthetic, efficient, treated like a Tech. Announ. for Xceck).

The AI display permanently shows the core synthesis that pilots had to track and update in the back of their mind, shared at several key points only, or upon change.

This also reflects the use of **modes** inside the system, nice for formal verification purpose (critical systems).

# DEMO w. Diversion

## Reacting to a WX degradation

A RED condition (<ACARS / WX raw msg + analysis) propagates through the system

The STS DIVERSION procedure is popped, ack. (Xcheck) and items injected back into FMS

Step # 1: IDENTIFY suitable airport (registered ALTN is preferred)

Step # 2: CONFIRM mission UPDATE (destination APT swaped)

## **LIVE DEMO** → Reacting to a A/SKID failure (short RWY on arrival, as in PICASSO in flight prep.)

A YELLOW FMC A/SKID CTN condition propagates  
PERFOs are updated (LD)

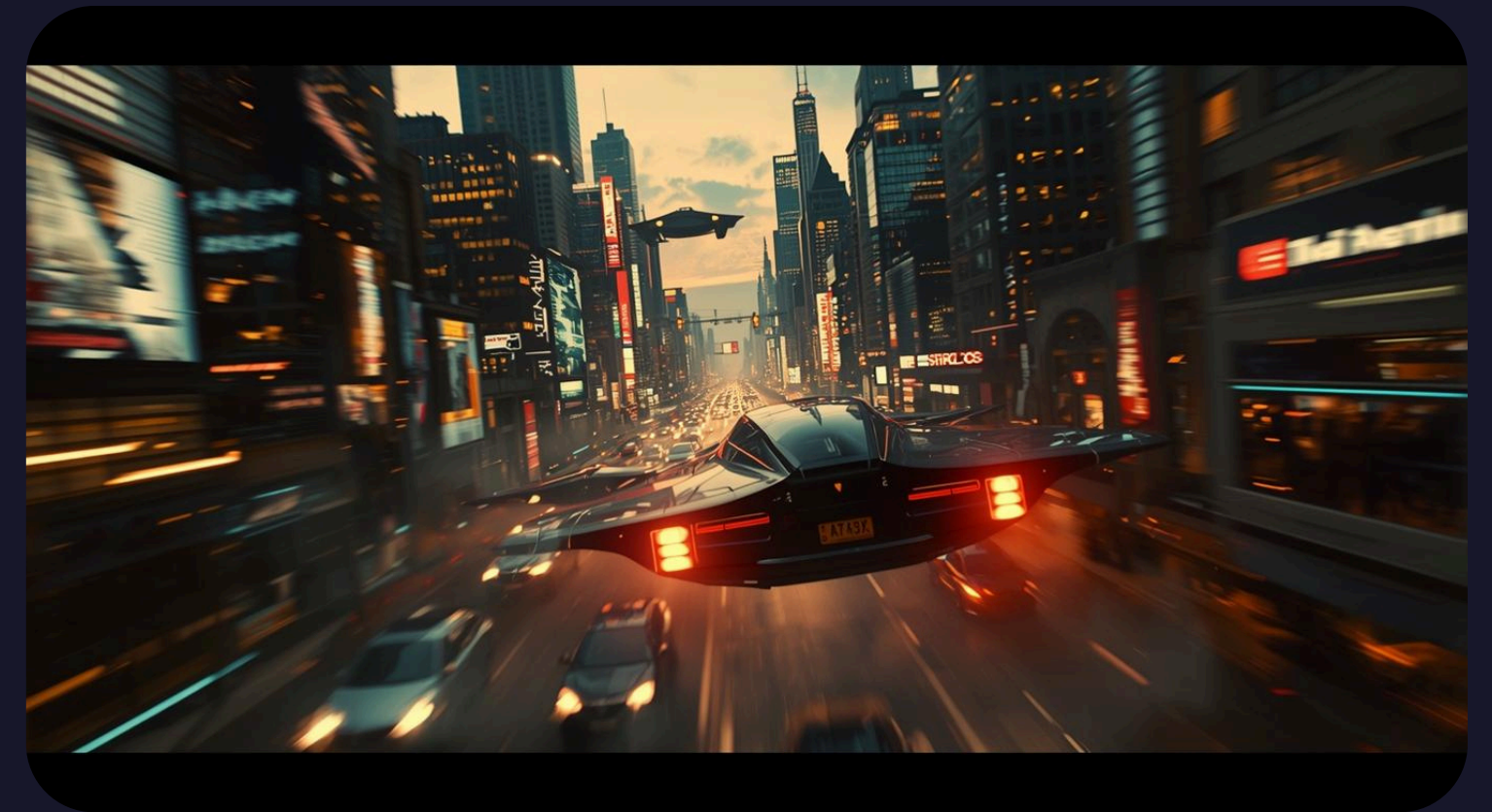
A RED condition (LDA < LD) propagates (PICASSO had a YELLOW LD condition before)

The CTN A/SKID procedure is popped, ack. (Xcheck) and items injected back into FMS

Then, as above:

The STS DIVERSION procedure is popped, ack. (Xcheck) and items injected back into FMS

(Steps # 1 and # 2 above)



## Flying Taxis

Transforming city travel with **quick aerial transport**.

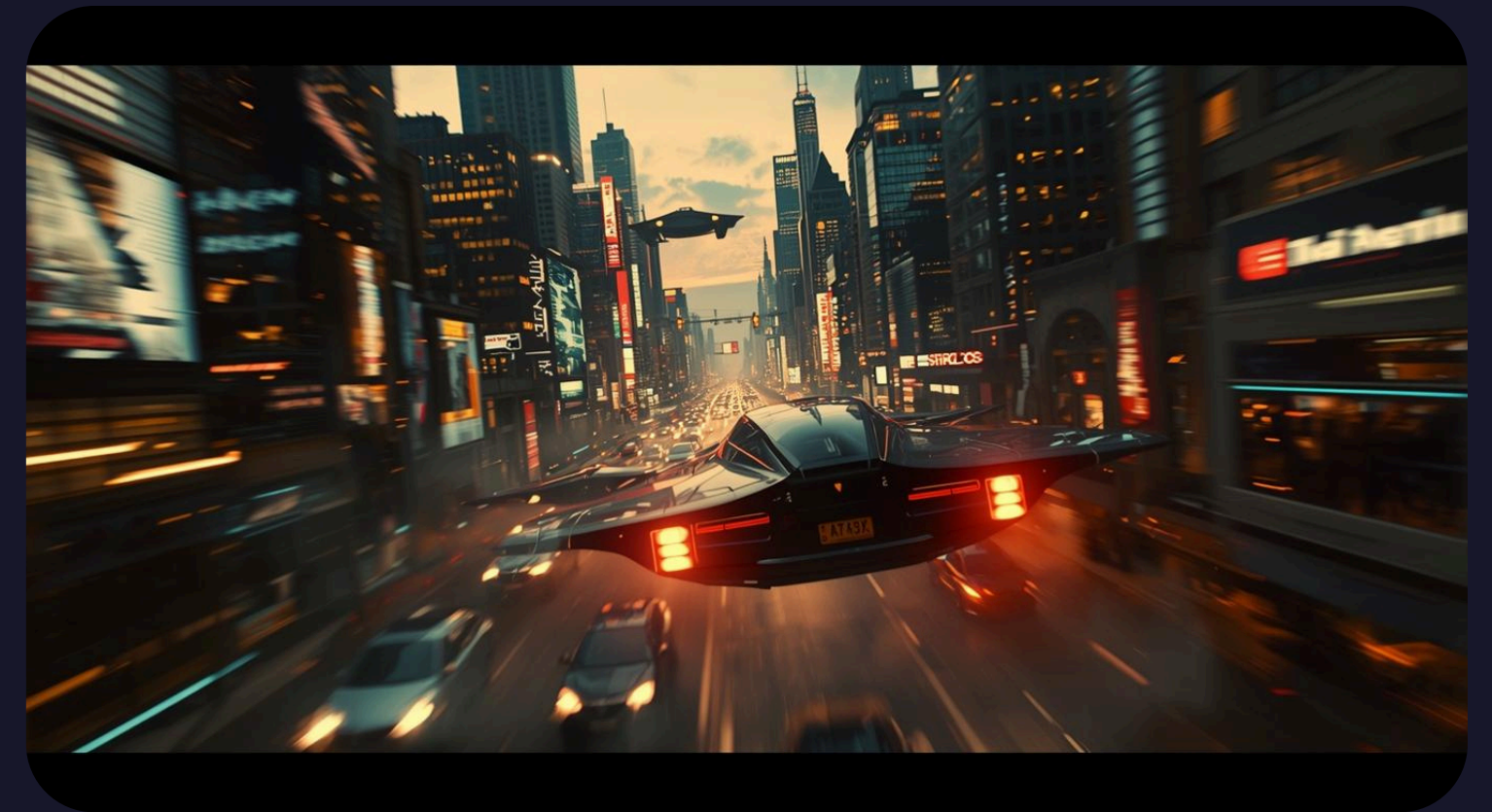
The compelling point:  
**DIVERSION is triggered when a RED condition arises in the PICASSO, just as human pilots would do by compliance**

→ **THE AI agents correctly processed all events and triggered a diversion, as expected (negociation of DIRTO, LNAV... again, not in the model, trivial to implement).**

# DEMO w. Diversion

```
[MissionAgent] PUP check @next_event_time : @34.0
simulate FMC caution message A/SKID
[18:23:33] AI: [Edition of FmcAgent registry]: {
  "STS": "[]",
  "CTN": "[A/SKID]",
  "WNG": "[]"
}
18:23:33: [18:23:33] AI: [Edition of GroundAgent registry]: {
  "AG_TYPE": "Cessna CRJ1000 Target: E UMLE"
```

The A/SKID failure is simulated and a CTN msg apperas on the FMC.



## Flying Taxis

Transforming city travel with **quick aerial transport.**

```
"RG": "RGA < RG, and diff. between 21:54:25: [21:54:29] AI: [Edition of PilotAgent registry]: {
  "PROC": "Procedure is ILS CatI, pre "situation": {
    "lf_picasso": {
      "FMC": "Y",
      "DEST_WX": "G",
      "DEST_LD": "R",
      "DEST_RG": "G",
      "DEST_PROC": "G",
      "ALTN_DEST_WX": "G",
      "ALTN_DEST_LD": "Y",
      "ALTN_DEST_RG": "G",
      "ALTN_DEST_PROC": "G"
    },
    "lf_situation": "1 Red ( DEST_LD ), 2 Yellows ( FMC, ALTN_DEST_LD ), 6 Greens\n\nRED condition #
    ACCESSIBLE**\n\nWe are legally authorized to resume approach until IF.\nComputing recovering s
    ALTERNATE AIRPORT in the vicinity.\nSTAND BY.",
    "cmd_update_interpretation": "Passing Top of Climb, leveling off, accelerating to 320kts, and se
  },
  "fcp": {
    "N1_SEL": "92",
    "ALT_SEL": "32000",
    "LDG_GEAR": "UP",
    "SPD_SEL": "320",
    "FLAPS": "0",
    "ALT_SOURCE": "1013"
  },
  "cmds_1": {
    "REVERSE": "DISARMED",
  },
}
"DEST_APT_3": {
  "ID": "LFML",
  "RWY": "13R",
  "Altitude": "74ft",
  "Procedure": "ILS 13R",
  "MSA": "4200ft",
  "Minimas": "215ft",
  "NOTAMS": "",
  "Limits_LDG": {
    "RGA": "2.1%",
    "LDA": "2100m"
  },
  "Perfs_LDG": {
    "RG": "2.8%",
    "LD": "2550m"
  },
  "COLOR_LDG": {
    "LD": "RED",
    "RG": "GREEN",
    "PROC": "GREEN"
  },
  "EXPLAIN_COLOR": {
    "LD": "LDA > LD IS FALSE, yielding RED color",
    "RG": "RGA < RG, and diff. between RG and RGA is MORE than company MARGIN for climb gradients (0.5%), yielding GREEN color",
    "PROC": "Procedure is ILS CatI, precision approach, yielding a GREEN color."
  }
}
```

**A RED LD condition is detected  
@destination**

The landing distance (LD) is now 2550m, more than the available distance for landing on the arrival airport's RWY (2100m).

# DEMO w. Diversion

```
}
21:54:29: [21:54:32] AI: [Edition of MissionAgent registry]: We POP @20.3: **procedure -> CTN A/SKID**
21:54:32: [21:54:32] AI: [Edition of MissionAgent registry]: Next event: TOD -> Set speed to 280kts set N1 to 75, 34.0, 100, 17, 2500
21:54:32: [21:54:32] AI: [Edition of ProcAgent registry]:

QRH -> STS DIVERSION (CRJ1000) / Operational

ACCESSIBLE AIRPORTS IN VICINITY -> CHECK

MISSION -> UPDATE

END OF PROCEDURE ->

21:54:32: [21:54:38] AI: [Edition of MissionAgent registry]: We POP @21.5: **ACCESSIBLE AIRPORTS IN VICINITY -> CHECK**
21:54:38: [21:54:38] AI: [Edition of MissionAgent registry]: Next event: MISSION -> UPDATE, -98.0
21:54:38: [21:54:38] AI: [Edition of ProcAgent registry]:

QRH -> CTN A/SKID (CRJ1000) / Operational

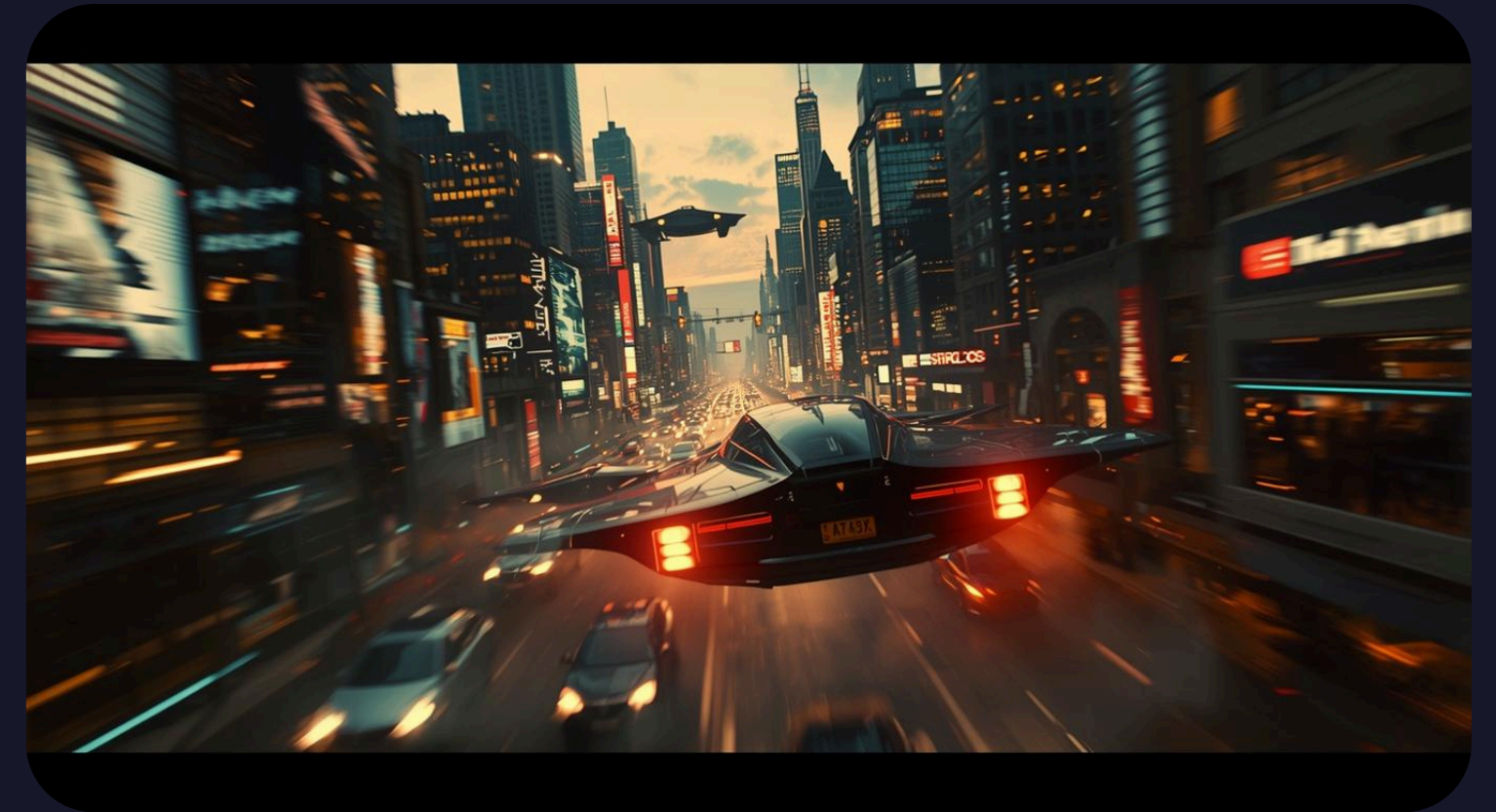
ANTI-SKID -> CHECK ON

BRAKE PRESS -> CHECK NORM

HYD PRESS -> CHECK NORM

If msg persists -> Set ANTI-SKID OFF and check landing distance

END OF PROCEDURE ->
```



## Flying Taxis

Transforming city travel with **quick aerial transport**.

**The CTN A/SKID and STS DIVERSION procedures both arise (Tech Ann. + Xcheck) and are injected back into the FMS**

Then, the alternate airport on arrival is confirmed **SUITABLE** for landing (step #1, fetching data and analysing).

```
21:54:38: [21:54:38] AI: [Edition of InfoAgent registry]: diversion {
  "explanation": "DIVERSION: LFMN IS NEW DESTINATION AIRPORT (alternate preferred if not RED). LFSE IS NEW DESTINATION ALTERNATE AIRPORT (within 200nm, LD condition RECOVERED). NEW LF SITUATION: 0 Red, 1 Yellow (DEST_LD)",
  "new_ground_keys": {
    "DEST_APT_3": {
      "ID": "LFMN",
      "DOW": "021"
    }
  }
}
```

# DEMO w. Diversion

```
21:54:38: [21:54:41] AI: [Edition of MissionAgent registry]: We POP @21.9: **ANTI-SKID -> CHECK ON**  
21:54:41: [21:54:41] AI: [Edition of MissionAgent registry]: Next event: BRAKE PRESS -> CHECK NORM, -198.0
```

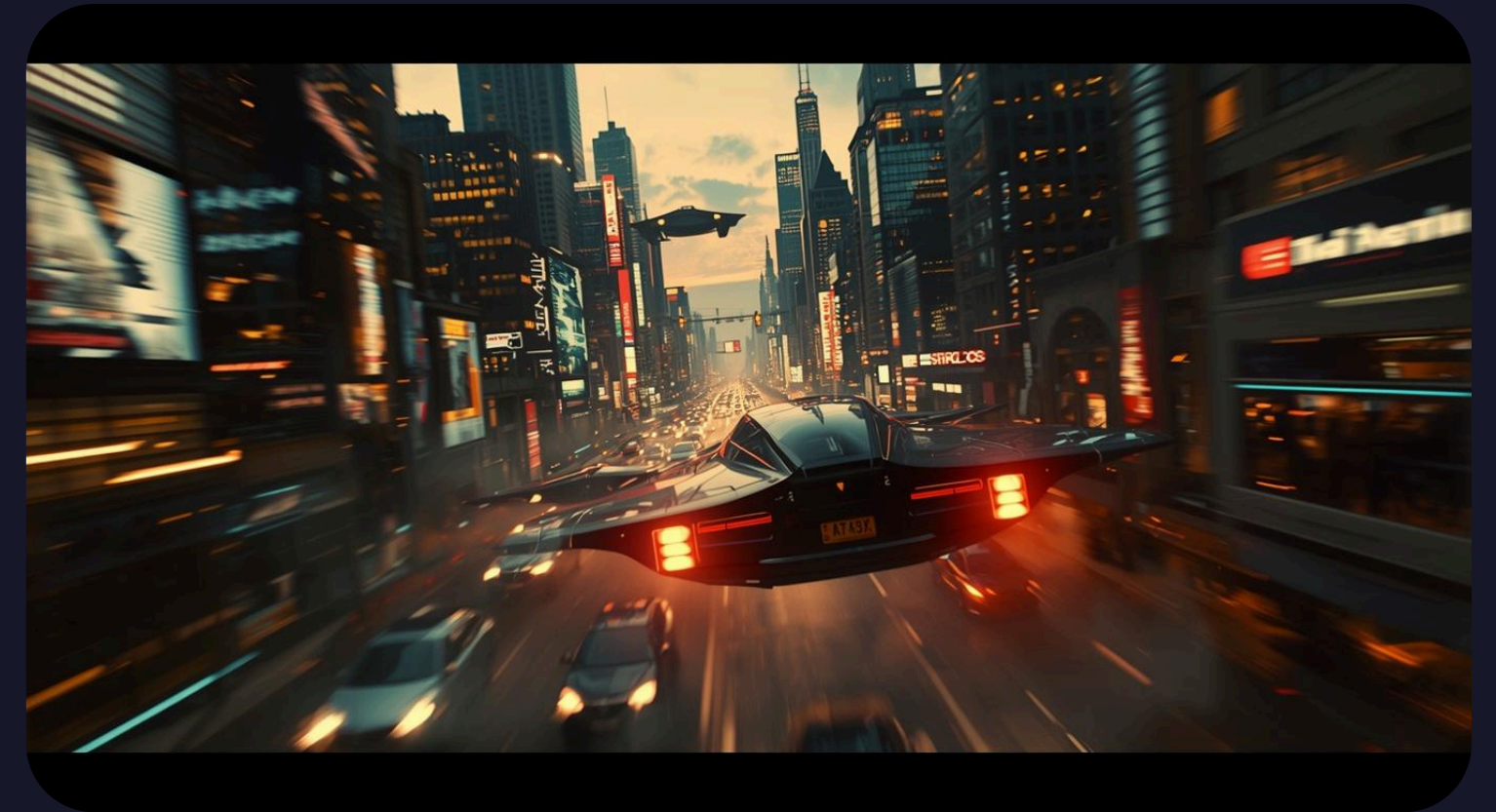
```
}  
21:54:44: [21:54:47] AI: [Edition of MissionAgent registry]: We POP @22.7: **BRAKE PRESS -> CHECK NORM**  
21:54:47: [21:54:47] AI: [Edition of MissionAgent registry]: Next event: HYD PRESS -> CHECK NORM, -197.0  
21:54:47: [21:54:53] AI: [Edition of MissionAgent registry]: We POP @23.1: **HYD PRESS -> CHECK NORM**  
21:54:53: [21:54:53] AI: [Edition of MissionAgent registry]: Next event: If msg persists -> Set ANTI-SKID OFF and check landing distance, -196.0
```

```
}  
21:54:53: [21:54:59] AI: [Edition of MissionAgent registry]: We POP @23.9: **If msg persists -> Set ANTI-SKID OFF and check landing distance**  
21:54:59: [21:54:59] AI: [Edition of MissionAgent registry]: Next event: END OF PROCEDURE ->, -195.0
```

```
}  
21:55:05: [21:55:08] AI: [Edition of MissionAgent registry]: We POP @25.5: **MISSION -> UPDATE**  
21:55:08: [21:55:08] AI: [Edition of MissionAgent registry]: Next event: END OF PROCEDURE ->, -97.0  
21:55:08: [21:55:14] AI: [Edition of MissionAgent registry]: We POP @25.9: **END OF PROCEDURE ->***  
21:55:14: [21:55:14] AI: [Edition of MissionAgent registry]: Next event: TOD -> Set speed to 280kts set N1 to 75, 34.0, 100, 17, 2500
```

Though first item from the STS proc. is loaded faster than the CTN proc., the priority applies starting from the following item

The MISSION → UPDATE is the 2nd item of the STS DIVERSION procedure.



## Flying Taxis

Transforming city travel with **quick aerial transport.**

```
21:55:14: [21:55:16] AI: [Edition of PilotAgent registry]: {  
  "situation": {  
    "lf_picasso": {  
      "FMC": "Y",  
      "DEST_WX": "G",  
      "DEST_LD": "Y",  
      "DEST_RG": "G",  
      "DEST_PROC": "G",  
      "ALTN_DEST_WX": "G",  
      "ALTN_DEST_LD": "G",  
      "ALTN_DEST_RG": "G",  
      "ALTN_DEST_PROC": "G"  
    }  
  },
```

After the update, the alternate APT gets promoted as new destination (YELLOW LD condition)

→ CCL: The AI agents carried out a normal yet rare and demanding cognitive task just as a human crew would have.



# Contact Information

Let's Discuss the Future:  
**PROTOTYPING & CERTIFICATION**

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4 modes:

- full autonomous,
- pilot on board (PM or PF),
- flight info (PAX, branding).

Human identified as pilot (always captain) or PAX. Copilot version and Full autonomy are based on the same design (no extra dev).

Voice commands from human and FMS events are ORDERS to be executed.

FMS events (incl. procedure items) are seen as technical announcements for the crew, subject to active / passive Xcheck (trigger delay).

All airborne applications with specs and onboard data are now relevant for AI agents. Same for any industry w. critical systems.

Code Python, agentic framework **DSPy Stanford**. Redundant GPU boards with hardened RT Linux OS.

**CERTIFICATION:** ML hassle is gone! We get **determinism** and **explainability**. And sys. verification.

**PROTOTYPING:** If access to onboard data, for technical watch on a new critical tech, < 1y.