Look Houston…No Hands!

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What percentage of time would you be comfortable with a machine getting

YOU

from point A to point B

AUTONOMOUSLY?

0-40%

50-80%

90+%

People

Tesla Driver Appears Asleep at the Wheel on Calif. Highway in Video Footage: 'She Was Conked Out'

A woman appeared asleep inside her Tesla last week as it raced down a California highway — and it was all caught on camera.

Feb 9, 2023

ABC7

Caught on video: Tesla driver apparently asleep at the wheel on 15 Freeway in Temecula

A driver recorded another woman who was apparently asleep at the wheel of a Tesla traveling along a California freeway.

Feb 6, 2023

Daily Mail

Woman is filmed 'asleep' at the wheel of her Tesla for 15 minutes on California highway

California motorists horrified as Tesla driver appears to be asleep at the wheel; Female motorist is wearing sunglasses and appears...

Feb 3, 2023

NBC News

Tesla driver slept as car was going over 80 mph on Autopilot, Wisconsin officials say

Wisconsin authorities ticketed a man who was seen sleeping behind the wheel of his Tesla as the car drove itself in a mode known as...

May 18, 2021

Credit: Google.com “driver asleep in Telsa”

What if I said

YOU ARE

comfortable with a machine getting you from point A to point B while automated

75-90%

of the time?

Image Credit: Midjourney (AI text to Image Generation)

Airline Flight Statistics

877 Million Passengers

*From Jan to Oct 2023

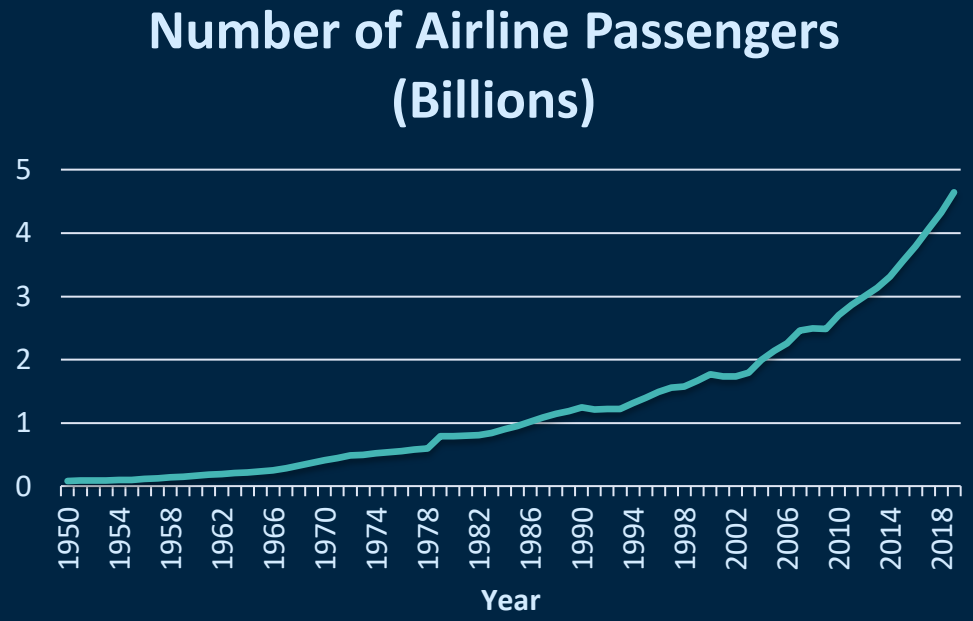
Source: https://www.transtats.bts.gov/Data_Elements.aspx?Data=4

7.7 Million Flights

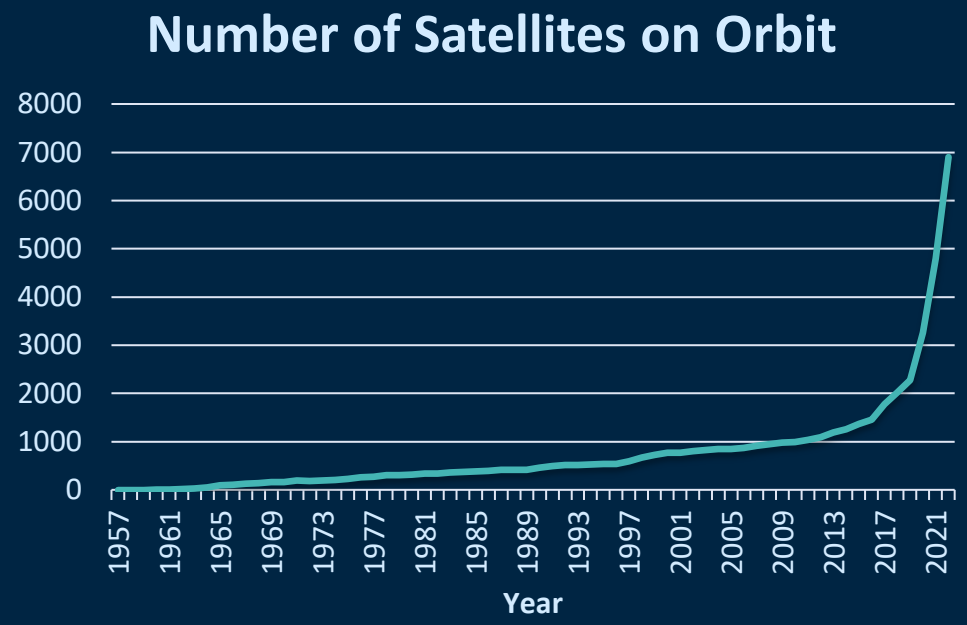
*From Jan to Oct 2023

Source: https://www.transtats.bts.gov/Data_Elements.aspx?Data=4

Air vs. Space



Data Credit: https://www.iea.org/t_c/termsandconditions/



Data Credit: https://www.statista.com/statistics/1422809/number-of-satellites-cataloged-decayed-orbit/#:~:text=According%20to%20an%20online%20catalog,having%20launched%20in%20October%201957.

Project Goal

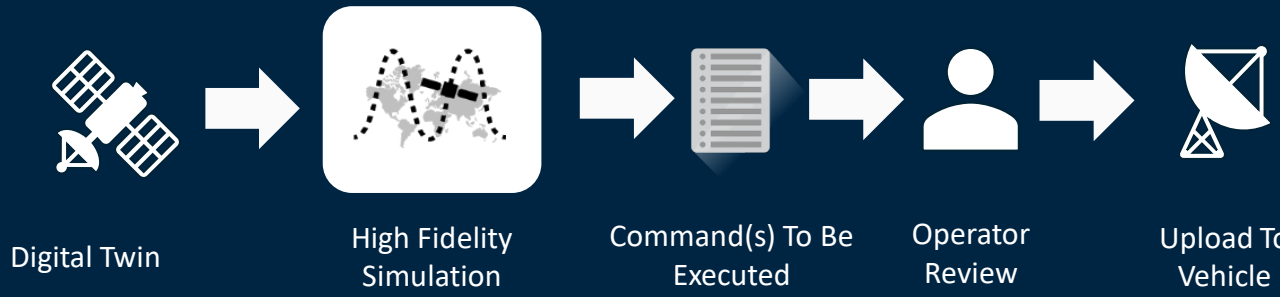
Create an Artificial Intelligence/Machine Learning (AI/ML) system to fly a vehicle ***autonomously or with minimal human interactions*** while ***optimizing*** the three main areas of a satellite, i.e., ***Data Collection***, ***Data Downlinking***, and ***Vehicle Health*** from either the ground or onboard the vehicle

Building AI/ML Model Framework and Models

The General Idea

AI Onboard Vehicle:

AI On the Ground:



Attempt 1: The Monolithic Model(s)

- Built a complicated model whose actions contained several parameters
  - Normal RL models' actions are a list of things to do like kick, jump, run
  - This RL model's action space was more like:
    - Kick (velocity, angle)
    - Jump (height)
    - Run (distance, velocity)
- Model was given a state and learned what actions it should take and the parameters it should pass to those actions
- ***VERY*** long training times for a 2-hour simulation
  - (**6+ hours**)
- Didn't quite converge to desired results
  - Too much Jitter in model

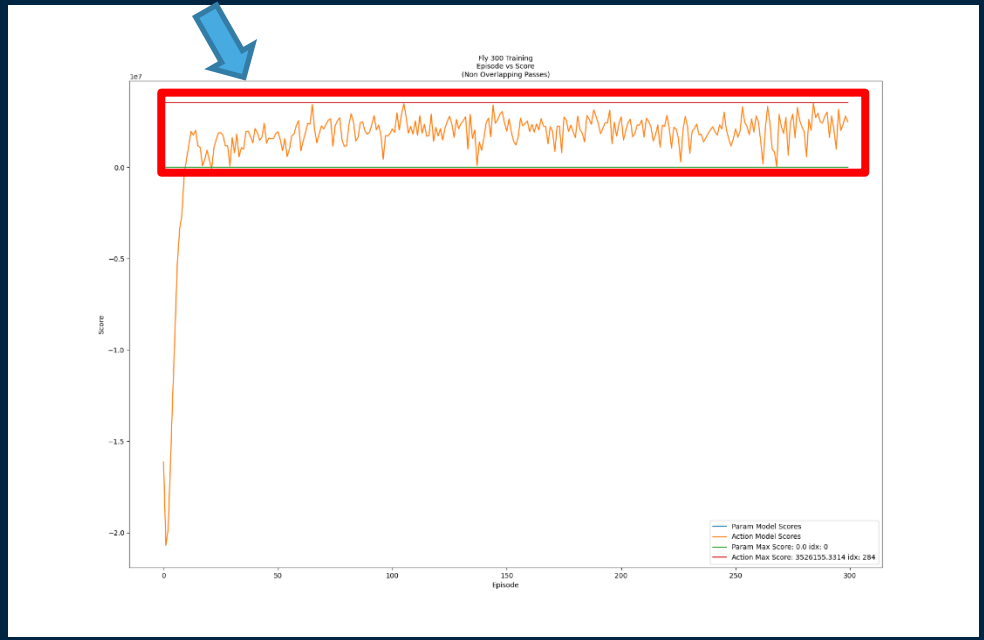
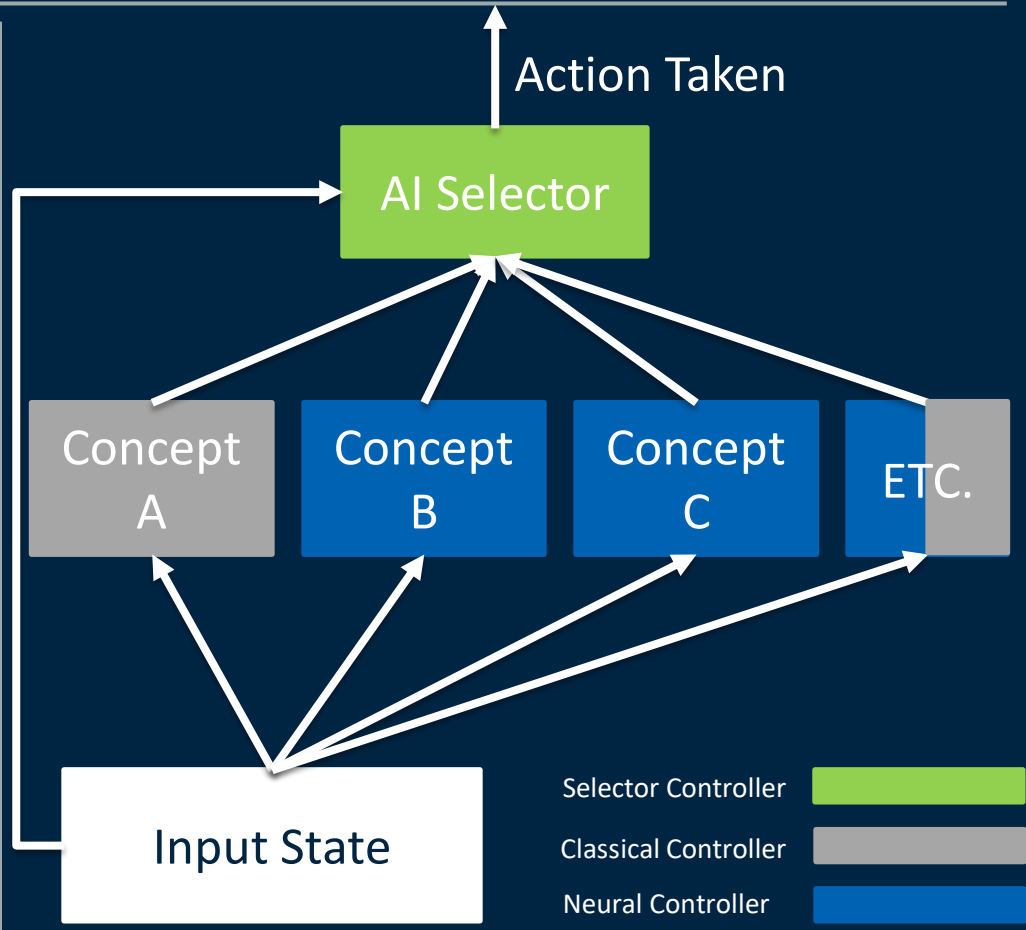


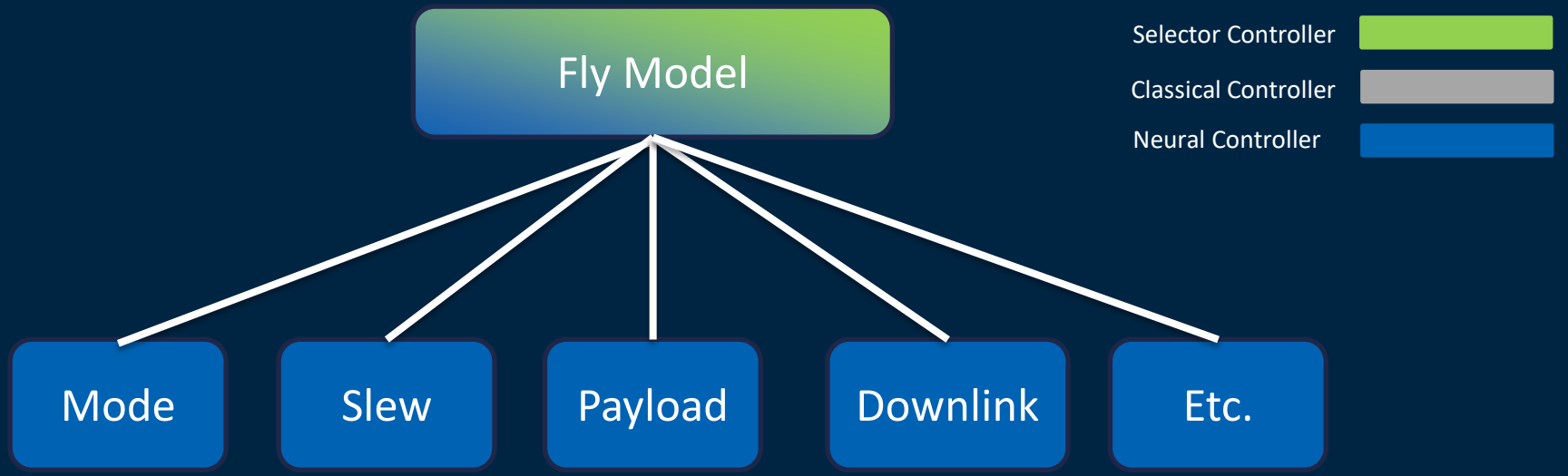
Image Credit: Space Dynamics Laboratory

Concept Network

- Selectors
  - Could be AI based or Classical
  - Chooses the best Concept Node based off of State
  - Uses Selected Concept Node Action as its output action
- Concept Nodes
  - Could be AI based or Classical algorithms
  - Based off of State it chooses the best action to take for the goal of the concept

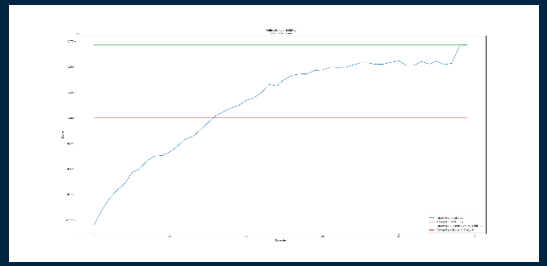


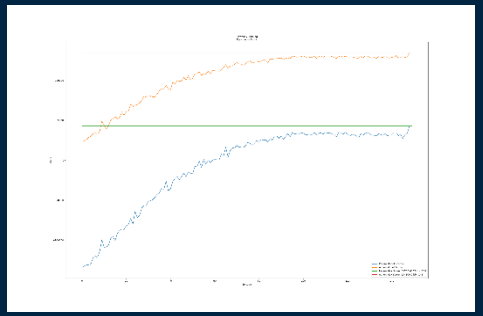
Concept Network

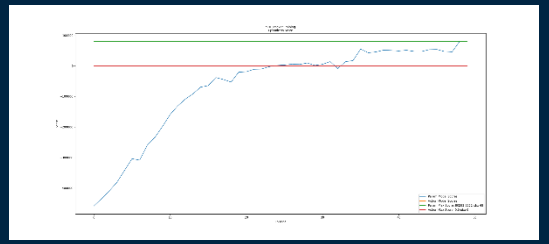


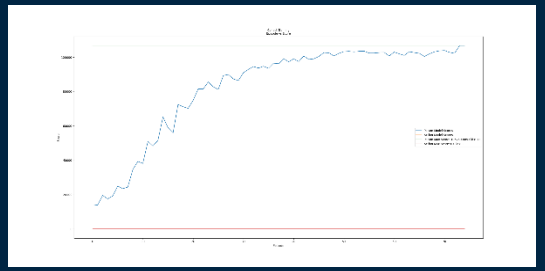
Attempt 2: Modular Concept Network

- Broke Monolithic Model into sub models that do ***specific tasks***
- Decreased training time per model
  - Average training time is between 30 min to 1 hour
- Allows for modular models to be added or removed
- Complete Model Framework allows for either models or proven algorithms to be interchanged









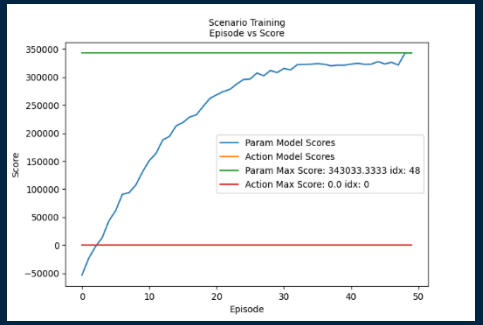


Image Credit: Space Dynamics Laboratory

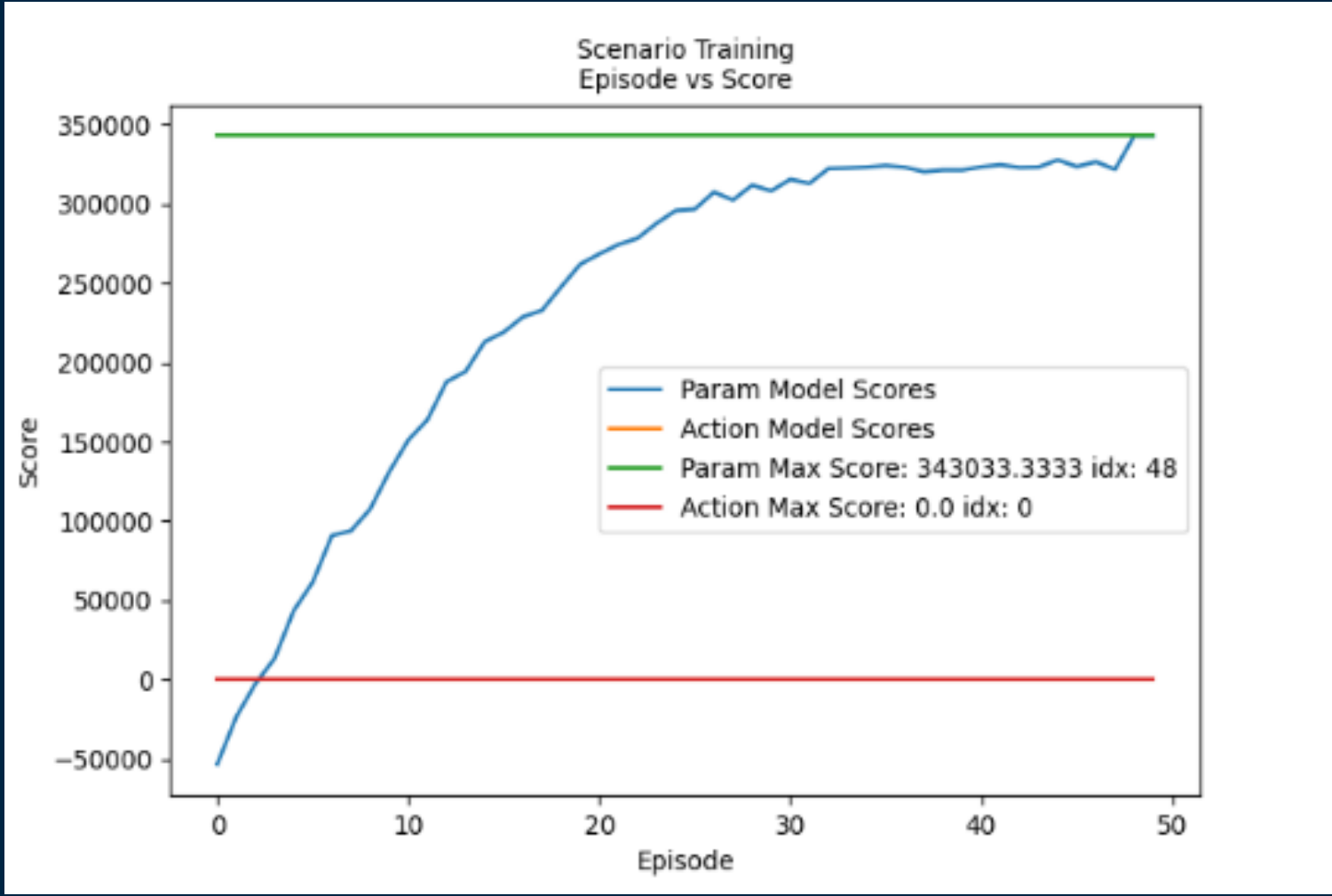


Image Credit: Space Dynamics Laboratory

Video Demo

Video Credit: Space Dynamics Laboratory

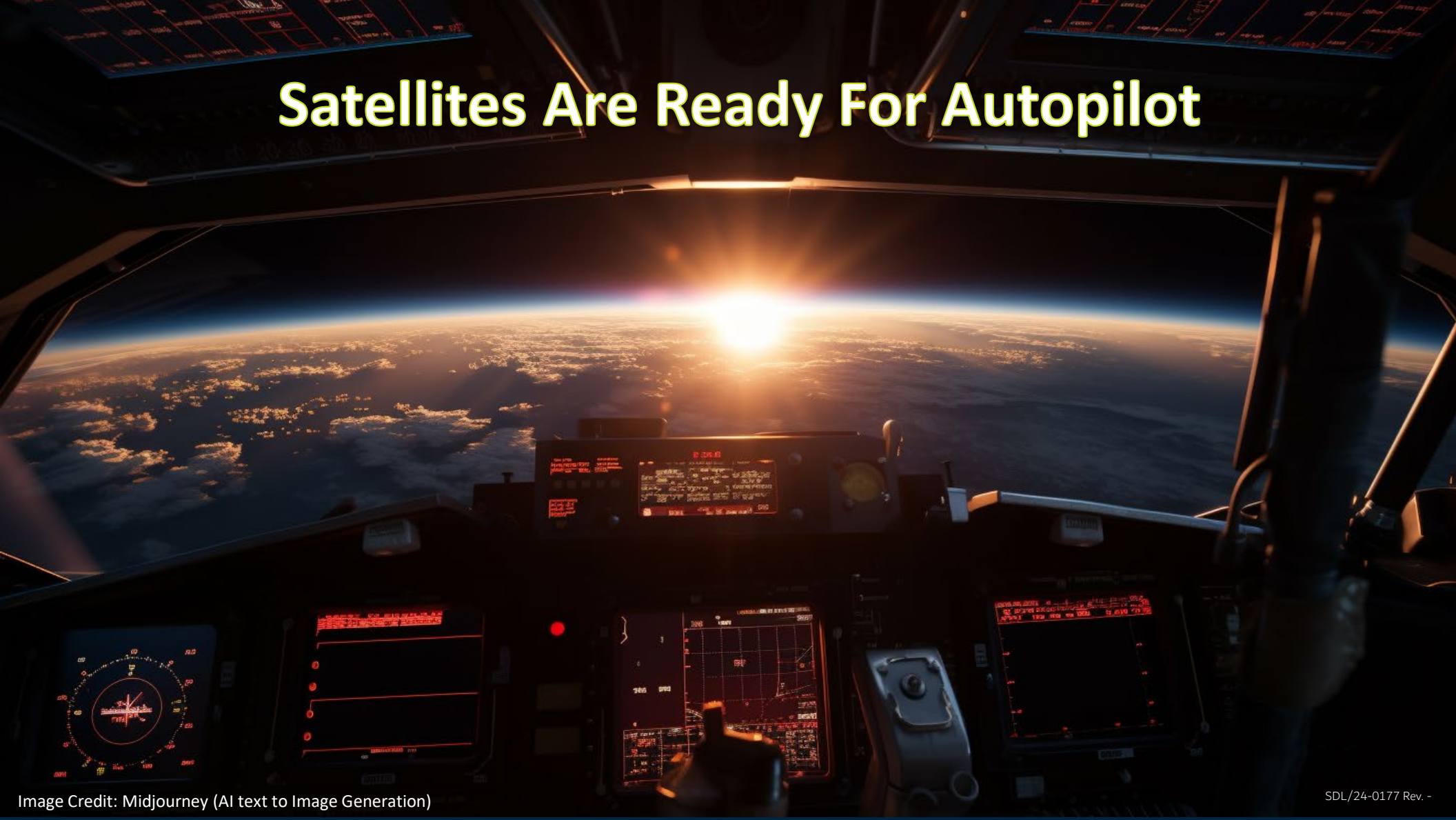
Satellite Operations need to feel like this…

Image Credit: Midjourney (AI text to Image Generation)

Not this…..

Image Credit: https://en.wikipedia.org/wiki/Christopher_C._Kraft_Jr._Mission_Control_Center

Satellites Are Ready For Autopilot



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