

The world is so obsessed with the new gimmick “MCAS” that seasoned investigators too get caught in the same web. While the MCAS undoubtedly played a significant role in the Ethiopian ET302 accident in 2019, there is virtually no focus on the ‘who’ was flying the B737Max aircraft and using which reference?

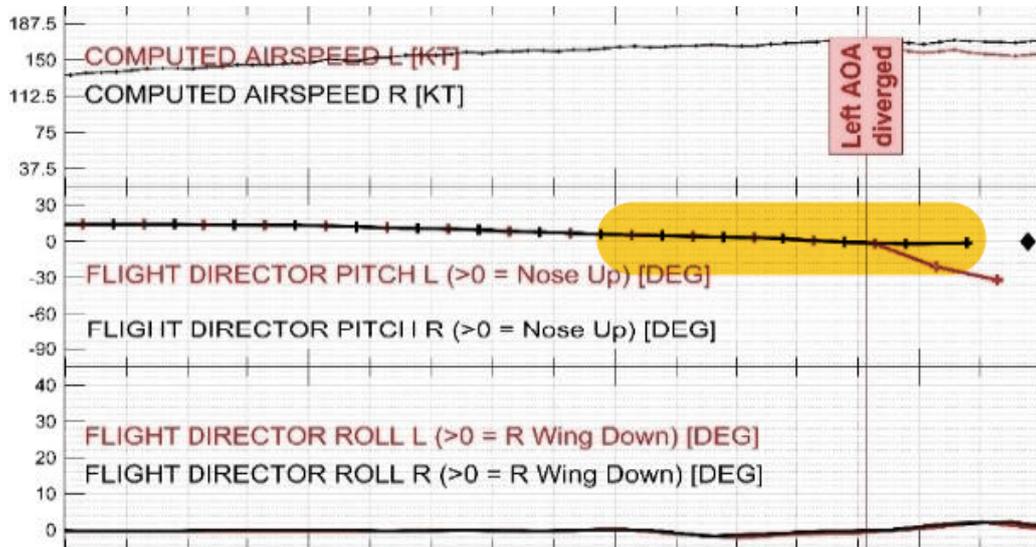
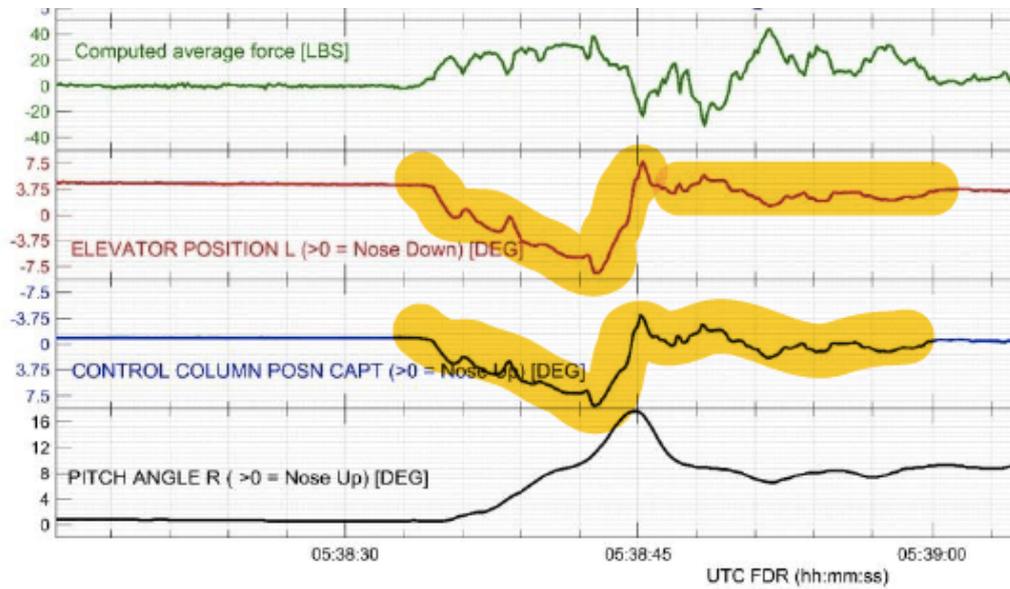
Read the interim report [here](#)

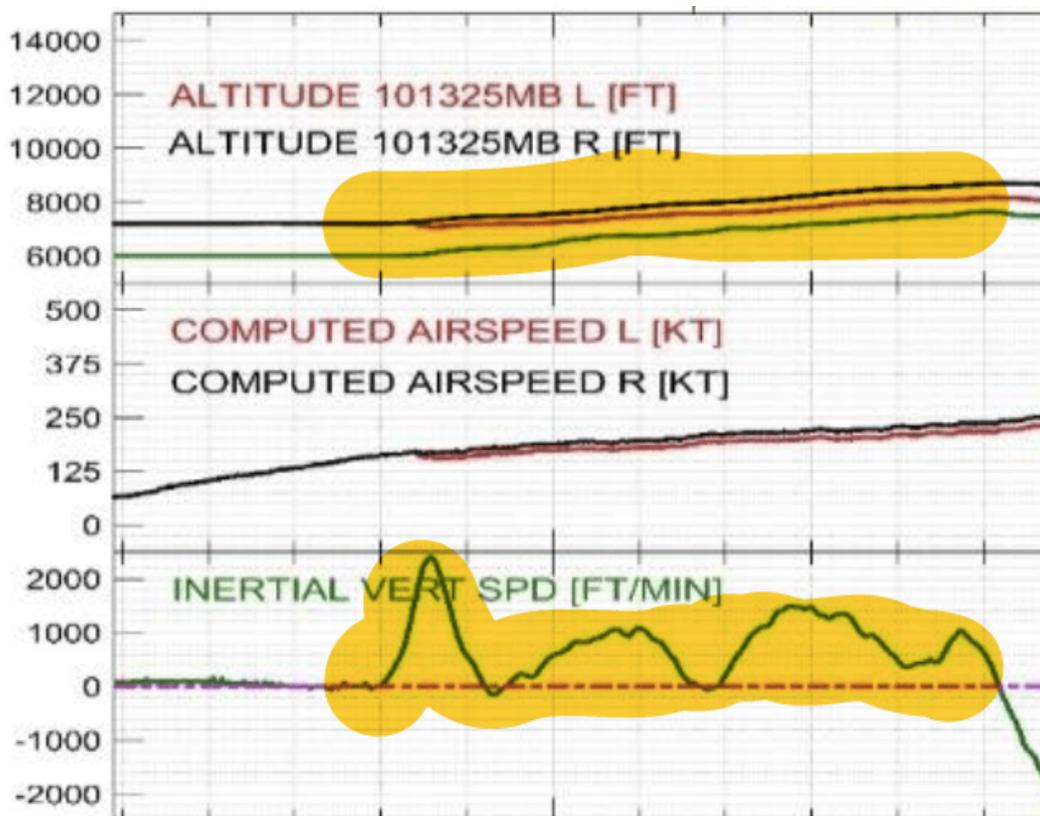
The initial few moments

Once VR was reached, at 05:38:34 the F/O called “rotate” and the aircraft liftoff. At 05:38:43 “positive rate” confirmed, at about 50 ft radio altitude, the flight director roll mode changed to LNAV.

At 05:38:44, shortly after liftoff, the left and right recorded AOA values began deviating. Left AOA decreased to 11.1° then increased to 35.7° while value of right AOA indicated 14.94°.

Then after, the left AOA value reached 74.5° in $\frac{3}{4}$ seconds while the right AOA reached a maximum value of 15.3°, the difference between LH and RH AOA was greater than 59° and continued to be until the final loss of control





Initial climb profile

What prevented the aircraft from climbing?

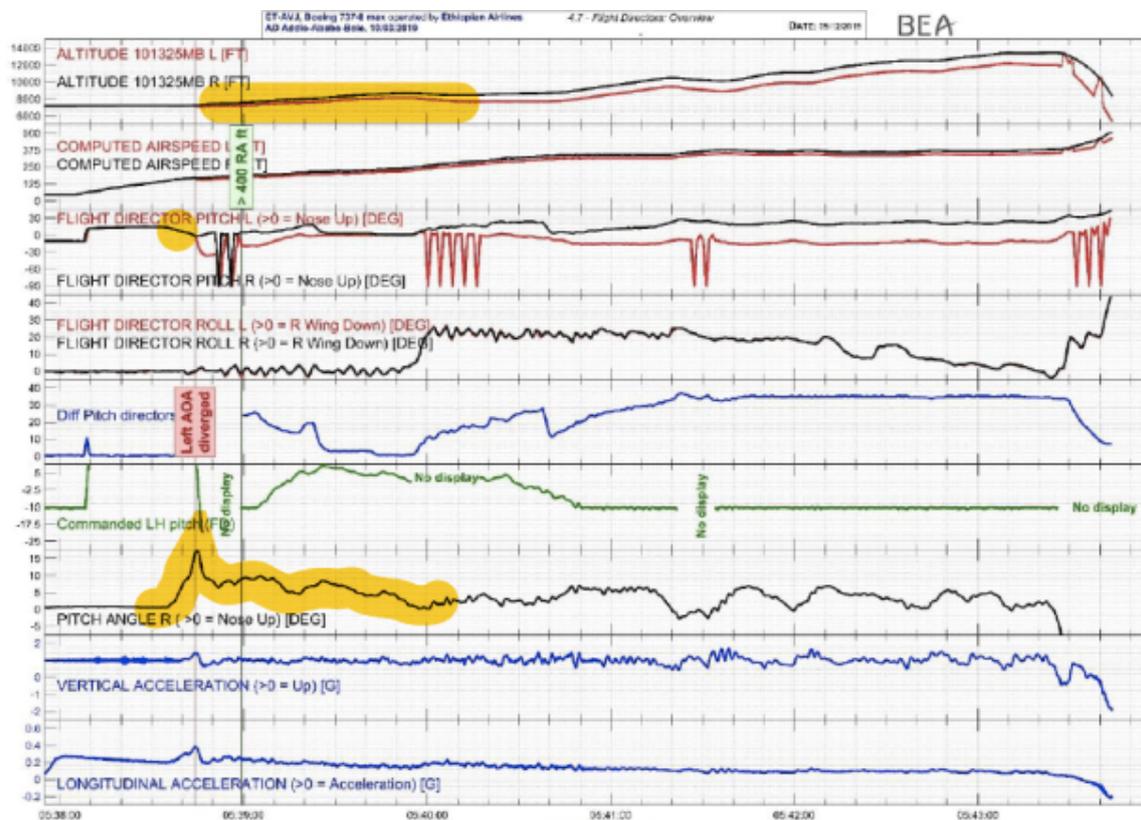
The aircraft performed a normal takeoff roll and as per the interim investigation report, things began changing at 05:38:44 UTC when the Angle of Attack (AoA) readings began to diverge. The left AoA being the rouge one initially showing pitch down thereafter pitchup in excess of 74degrees.

The Flight Director (FD) which guides the pilot flying shows 15 deg during the takeoff roll. After rotation speed, the FD command reduced to 0 deg. The pilot rotates to 17.4 deg and then pitches down to maintain a vertical speed of zero.

What led the AoA to give faulty readings and the FD to show pitch 0 has not

been investigated in the excitement of nailing the MCAS.

Thereafter, the AoA difference causes the minimum speed to increase and stall warning/stick shaker to trigger. The vertical speed and pitch remains shallow as the aircraft oscillates on the vertical axis due pilot input and the movement of the manual/MCAS pitch trim.



The question which arises is, what flight parameter reference was the crew following to fly the aircraft? Were they chasing the FD guidance?

The FD reference was blanked out due to AoA discrepancy a few time but the flight profile continued to be shallow. The Capt. who was the pilot flying did not hand over the controls to the Co-Pilot, who's flight parameters displayed were more accurate than the Capt.

The only reference to the pilot's reasoning

At 05:39:56, A/P disconnected automatically after remaining engaged for 32 seconds as the following logic conditions were reached:

- Climb command with climb rate too low for five seconds
- Airspeed low relative to the minimum operating speed which was erroneously calculated by the SMYD-1.

At the beginning of this phase, the airplane was climbing with an increasing vertical speed and a trend to pitch up. Once the autopilot engaged the autopilot tried to increase the airspeed, because of the minimum speed reversion (erroneous LH minimum operational speed based on erroneous LH AOA value).

Flight crew training

The Ethiopian Airlines pilot training program addresses the increased rates of loss of control in airline operations through **Upset Prevention and Recovery Training (UPRT)**. In addition, train the trainees to combat the continuing dominance of multi-crew human factors in accidents through Threat and Error Management (TEM) and Crew Resource Management (CRM).

The crew were aware of the Boeing **emergency procedure on Runway Stabilizer**, issued after the Lion Air accident.

Required by AD 2018-23-51

Runaway Stabilizer

In the event of an uncommanded horizontal stabilizer trim movement, combined with any of the following potential effects or indications resulting from an erroneous Angle of Attack (AOA) input, the flight crew must comply with the Runaway Stabilizer procedure in the Operating Procedures chapter of this manual:

- Continuous or intermittent stick shaker on the affected side only.
- Minimum speed bar (red and black) on the affected side only.
- Increasing nose down control forces.
- IAS DISAGREE alert.
- ALT DISAGREE alert.
- AOA DISAGREE alert (if the option is installed).
- FEEL DIFF PRESS light.
- Autopilot may disengage.
- Inability to engage autopilot.

FAA Emergency Directive

The crew were trained on Upset Recovery Training. Did they apply the procedure effectively or use the awareness of the procedure to improve the situational awareness needs to be debated.

Training gives a false sense of safety

The safety recommendations include the use of simulators for training.

Recommendation 4. The difference training should also include simulator sessions to familiarize with normal and non-normal MCAS operation. The Training simulators need to be capable of simulating AOA failure scenarios.

Training alone is not the solution for all the woes, its the quality or training standard which makes the difference. Most training programs are crammed with scenarios thereby unable to address the conceptual understanding issues. On the other hand it is assumed

that if pilots have been trained on dealing with a threat, the threat itself is eliminated. This false sense of safety is itself a risky.

mindFly analysis

Every pilot that meets with an accident has successfully passed a proficiency check. Despite this the aircraft encounters an undesirable state. The primary reason being lack of conceptual understanding of the foundation of flying.

| Skill Level/ Mental Function | Novice | Advanced Beginner | Competence | Proficient | Expert |
|------------------------------|-----------------|-------------------|-------------|-------------|-------------|
| Recollection | Non-Situational | Situational | Situational | Situational | Situational |
| Recognition | Decomposed | Decomposed | Holistic | Holistic | Holistic |
| Decision | Analytical | Analytical | Analytical | Intuitive | Intuitive |
| Awareness | Monitoring | Monitoring | Monitoring | Monitoring | Absorbed |

Dreyfus model of skill

In order to be proficient, the pilot needs to have better understanding of the subject so that the superior knowledge can be used to improve situational awareness and take a superior decision when faced with an unexpected event or the environmental parameters change.

The training program and assessment must be developed to meet these requirements. The final investigation report must address the training issues after having determined the root and contributory causes. The report must not be skewed towards the MCAS alone and skip training issues.

Return of B-737 Max Part 1. What about the AoA sensor that gave a false reading to the MCAS?

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