Examining the MAX

The objective of this article was to "Look specifically at the performance of the crews as they struggled mightily against the Maneuvering Characteristics Augmentation System or MCAS." So I would expect the simulation to reflect the actual conditions in the crew station to include the element of surprise, activation of the stick shaker, and the disagreement between the captain's and first officer's instruments (airspeed and altitude). To properly emulate the performance of the crew, the exact emergency procedures and the order of accomplishment as prescribed in the flight manual should have been followed as well.

Relative to "Taking control," it appears that the pilots in the simulator already knew the problem they were facing so the element of surprise was lacking. There is no mention of actuation of the stick shaker, disagreement in flight deck instruments, or following the procedures in the flight manual in their order of precedence.

Since the cause of the loss of control was known beforehand [in the hypothetical situation], the proper commands from the captain to the first officer were given precisely and unequivocally and did not follow procedures as given in the flight manual, to wit, the throttles were moved to idle. This was not in the flight manual. This eased the recovery procedure by reducing the nose-up pitching moment and decreasing speed. As pointed out in the article, speed is the enemy because the increase in elevator hinge moments could result in excessive control forces making recovery from a nose-low attitude difficult. So, the simulation was interesting, it showed recovery could possibly have been accomplished provided the pilots did not follow handbook procedures.

However, airline pilots assume emergency procedures have been verified and validated and, therefore, follow procedures. The MCAS is an "add on" to the stall identification system already in the 737NG. Since the MCAS was an "add on," [perhaps someone assumed] that the recovery procedures as provided for the 737NG would suffice. Thus, the simulation could have highlighted shortcomings in the procedures due to the addition of MCAS and their order of accomplishment. This could have been revealing and instructive.

In my experience, failures in a complex augmentation system are difficult to find, and maintenance procedures must be refined to catch these errors. A case in

point was when the connection to the pitch and yaw rate gyros on a fly-by-wire airplane were inadvertently reversed. The aircraft was lost on rotation for takeoff. One of the actions taken by the Accident Control Board was to intentionally crosswire the gyros on an impounded aircraft and perform the preflight checkout. The procedure did *not* find the problem. Thus, the preflight checkout procedures were revised.

Perhaps in a later investigative article, this aspect could be examined.

In conclusion, it was an interesting article, but it did not address the original objective in the article to "look specifically at the performance of the crews as they struggled mightily against the Maneuvering Characteristics Augmentation system or MCAS." It did not provide any insight as to what they faced or their performance relative to these challenges.

Overall, it did not provide observations or lessons learned that the AIAA should pass on to the aerospace community.

Herbert "Skip" Hickey
AIAA senior member emeritus
Dayton, Ohio
skiphickey@sbcglobal.net

Jet A fuel vs. batteries

The article "Flying electric" in the June Aerospace America acknowledges the comparative energy/mass issue between batteries and Jet A fuel, but, in my view, does not bring out the really stark issue for an all-electric aircraft. The energy density of state-of-the-art batteries is about 1 megajoule/kilogram (mj/kg). It has remained at or near that level for many years, in spite of plentiful motivation to improve it. The energy level of Jet A is 43 mj/kg. This is an enormous differential even given that only a fraction of the Jet A energy content is recovered as work. Moreover, unlike with batteries, the Jet A is burned off during flight, reducing the work required to power the airplane.

Thomas R. Brogan
AIAA associate fellow
South Burlington, Vermont
tcon4@juno.com

Accepting risk in aerospace

Dan Dumbacher hit the nail on the head in his June [Flight Path column], "Scar tissue," discussing risk tolerance in aerospace endeavors. When I was serving at NASA Headquarters as a Reagan policy appointee in 1984 (deputy chief scientist), I wanted to explore some possible further flight demonstration usage of a certain remotely piloted asset at NASA Dryden Flight Research Center in California [now NASA Armstrong]. It might have been an excellent platform for actual, rather than simulator-flown, air combat pitting fighter pilots against the AML ("adaptive maneuvering logic") computer program. When I spoke with those who had been involved with this asset, it quickly became clear that I had ruined their day by broaching the subject. Referenced were the health problems and divorces that would again arise from anxiety that a mistake might cause the aircraft to crash.

For Pete's sake! It was just a hunk of composites and metallics! If it piled in, nobody's mom would complain. If our flight research (Dryden's middle name!) isn't scattering some debris across the Mojave Desert, we're not trying hard enough. Yet, fear of failure rather than lust for success had ruled. By the way, I'm blaming NASA's culture rather than its leadership for this, as an excellent team occupied the administrator's office at that moment in history.

Perhaps our engineers and managers could be more aggressive if some really gifted spinmeisters from the political world were protecting them. Here's a sample press release: "NASA is pleased to announce that the ____ unmanned flight research vehicle has been tested to destruction, AS PLANNED, to capture data that will enable confident design of the Air Force's _____ combat aircraft."

Frank Hurley
AIAA associate fellow emeritus
Chapel Hill, North Carolina
classa2000@aol.com

Modifying bodies for space

Thanks for carrying the article "Homo sapiens astronauta" [July/August]. It is fascinating look at future possibilities, well presented by Adam Hadhazy.

Michael Michaud
AIAA senior member
Lawrence, Kansas
magmichaud@hotmail.com

Apollo proved importance of risk

In regard to the essay by Samantha Walters reflecting on today's space program ["Curb your disillusionment," July/August], I found her perspective to be honest, enlightening and telling, especially with regard to risk management. I gained inspiration for my career from Apollo, as did she. And as she did, I found an industry which in 1978 seemed more risk averse than I expected. Contrary to what her colleague stated in the essay, that Apollo may have taken on too much risk, I find that after a 41-year career of working high-risk development programs, Apollo displayed a surprisingly balanced approach to risk management to achieve their phenomenal accomplishments. System analysis and tests were coordinated to not emphasize one at the expense of the other, a great example being the inclusion of Apollo 10 in the flight test plan, intended to ensure that the entire system worked as simulated prior to the actual landing. There were some who thought at the time that the flight was a waste of time but it was actually an example of solid and prudent systems engineering and risk management, even under tremendous schedule pressure!

In the 1980s-90s, the mass introduction of computer-aided design, manufacturing and simulation emphasized the benefits of maturing designs without the need for as much testing as had been done previously, so a number of firm-fixed-price contracts were let to take advantage of the expected reductions in cost. This digital design and simulation focus also fostered the expectation that these designs should work the first time, and if they didn't, the fault was with the design organization's misuse of the new advanced tools, and not on the realities of "unknowns" in design and test, which these advanced tools could not entirely eliminate. An environment was created where taking risk in testing could prove embarrassing and costly, so the industry retrenched to the point where major systems can now takes decades, not years, to develop. And while computer tools have been phenomenal in furthering our ability to improve design and manufacturing, they still cannot eliminate risk, nor the need for testing and learning from failure.

Unfortunately, today's industry views any failure as a significant setback, many times resulting in the end of a program or effort, which can be very damaging to the nation. A recent example is the Falcon HTV-2, which, after two imperfect but very valuable flight tests, was terminated. Shortly thereafter, we discovered that our adversaries (who had started or advanced their own hypersonics programs as

a direct result of our Falcon HTV-2 effort) moved significantly ahead of us, and as a result our nation now finds itself playing catch-up. This was brought into clear focus in a quote in a Washington Post article attributed to U.S. Air Force Gen. John Hyten, commander of U.S. Strategic Command, "We had a couple of failures (with the HTV-2), so we kind of stopped and regrouped to look at the overall structure, to make sure we understood the technology — what was working, what was not working. From my perspective, I'd have liked to have just learned from that mistake and kept going. Don't stop." To me he's saying, "Let's do what Apollo did … learn from the failures and continue toward the goal."

We understand that Cold War tensions fueled our commitment to Apollo. But that incredible program showed us what we can accomplish when we do commit ourselves to a goal, no matter the reason and no matter the cost. I would hope that as a nation, and as a planet, that we can make similar commitments going forward, not out of fear, but out of a desire to accomplish those goals that depend more on commitment and balanced risk-taking than about anything else.

Robert J. Wetherall
Program manager — Aerial Reconfigurable Embedded System
Lockheed Martin Aeronautics, Fort Worth, Texas
AIAA associate fellow
robert.wetherall@lmco.com

Navigating for Apollo 11

I just finished reading John Logsdon article on Apollo 11 ["Winning the moon race," July/August]. John mentioned all the parties involved in the project and the key leaders. Unfortunately, he forgot to mention the instrumentation laboratory of MIT (now Draper) and its leader, Doc Draper. The instrumentation lab got the first Apollo contract on a sole-source basis to design the guidance, navigation and control, and computer for the mission. They got it because NASA was reluctant to use radio navigation, suspecting that the Soviet Union would jam the system if they fell behind. The instrumentation lab proposed a self-contained inertial navigation system similar to the one they designed for the Polaris missile. The Apollo guidance computer that used integrated circuits was the beginning of the digital era.

Eli Gai
Retired vice president of engineering, Draper
AIAA fellow

elig1944@gmail.com