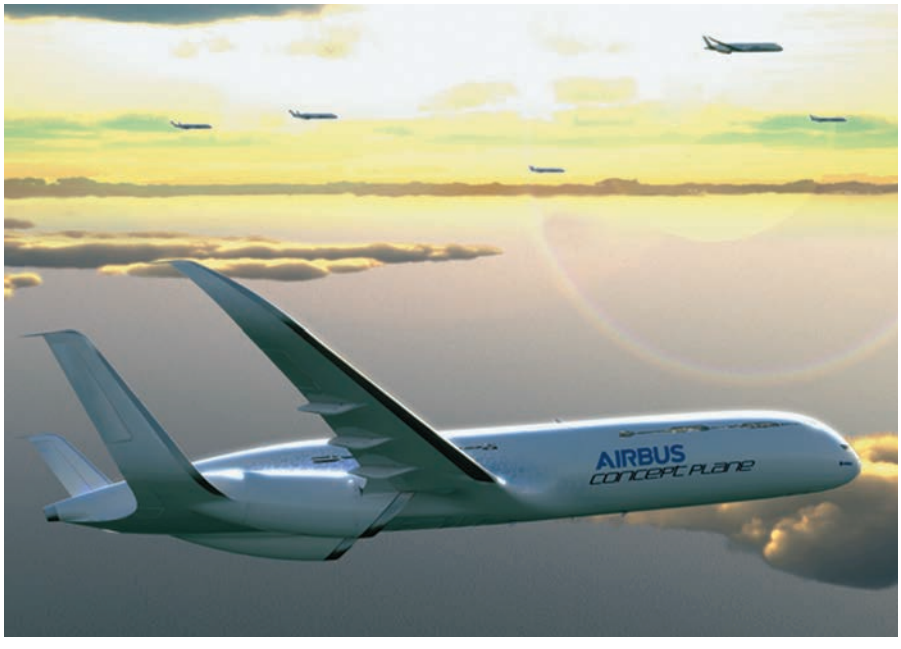
Pilot Optional Aircraft → explained



BY GORDON WALKER, AME 'E',
Professor of Avionics
Centennial College

I recently reconnected with a colleague of mine from the 1980s. His career has taken him into the engineering and design side of the business, and he was weighing the merits of two possible new job opportunities. The allure of a teaching position at a community college was strong, but ultimately he opted to remain active in the field of aircraft development and design. "They offered me a job working on POAs, Gordo – airplanes without pilots! It's like an AME's ultimate fantasy come true!"

POAs (Pilot Optional Aircraft) are relative newcomers to the aviation world, but their presence is quickly becoming conspicuous. More familiar is the pilotless Drone aircraft, which has been with us for some time now. Used largely for military operations, particularly in a reconnaissance role, drones, or UAVs (Unmanned Aerial Vehicles) were used extensively during the Vietnam War, and have continued to be a key element of aerial warfare ever since. (Recall the American UAV captured by Iran in December 2011).

UAVs can be programmed to fly a specific route, or controlled by a pilot/navigator on the ground. Remotely piloted vehicles (RPV) are totally controlled by the pilot/navigator on the ground, whereas semi-automatic and automatic unmanned aircraft generally have the ground-based controller monitoring and controlling take offs and landings, while the vehicle flies a pre-programmed route.

A fully autonomous UAV does not rely on any control input from the ground, and is capable of adjusting its pre-programmed route as conditions change. Information from sources such as TCAS or ADS-B can be utilized by the autonomous UAV to determine manoeuvring strategies without control commands being broadcast from any external source.

A POA has the capabilities of a fully autonomous UAV, but with the added option of carrying a human pilot on board. This format allows computers to do what they do best and humans to do

what they do best, a feature which many feel has been handled quite poorly up until now with regard to fly-by-wire/autoflight systems. By this, I mean that we currently have computers doing the flying, and pilots monitoring the autopilot computers while it should be the other way around, with pilots doing the flying, and the computers monitoring the pilot's performance to ensure safety is not compromised.

The advantages of employing an aircraft without a human pilot on board are many and varied, but the commonly used catchphrase explaining the types of missions for which UAVs are best suited is "dull, dirty, and dangerous."

As maintenance technicians we are acutely aware of the human factor risk of having people perform tasks that are tedious, repetitive, and of such duration as to lead to fatigue. Asking pilots to fly long surveillance missions creates potential human factor problems, specifically in the area of complacency and fatigue. Modern theatres of war pose the threat of chemical and nuclear weapons, and thus the unmanned aircraft is much better suited to these dirty and dangerous environments.

While the early versions of unmanned aircraft were little more than large-scale, radio-controlled models, advances in computer and avionics technology has led to a much more sophisticated array of guidance systems being made available for pilotless operations. Once again, global positioning systems (GPS) play a large role in the automated guidance of pilotless aircraft. It is important to note, however, that for most military operations, due to the covert nature of the

missions, and the fear of hostile interception, GPS is used only as a secondary navigational cross-check system, with the primary navigation being carried out by the inertial navigation/reference systems.

Inertial navigation systems (INS) do not require any input from external sources, such as radio stations, satellites or magnetic compasses. Once the INS has determined its present position on the ground, it measures accelerations in three dimensional space to determine its position during the course of the flight. Specific waypoints can be pre-programmed into the INS before the aircraft is dispatched, and it will fly that flight plan using full authority autonomous flight controls.

The testing and certification process for unmanned aircraft is understandably extensive, expensive, and arduous. This is one of the primary reasons for us having only really seen UAVs being used for military operations. Recently however, the new generation of pilot optional aircraft have been making their presence known in the civilian aircraft world, with several smaller aircraft manufacturers considering entry into the fray.

The fact that a POA can be flown with or without a pilot at the controls has enabled more lenient and less stringent flight testing opportunities. Regulators are far more receptive to allowing test flights of aircraft in which a human pilot can take over, should the autonomous flight control systems fail. This speeds up the certification process, and substantially reduces the manufacturer's research and development costs. The potential civilian market for a new generation of POA is

attracting the attention of smaller manufacturers who would not have considered entering into the competitive military arena. There are several applications for such an aircraft in government-controlled, non-military areas such as border patrols, maritime reconnaissance, search and rescue operations, disaster assessment and relief, forest fire fighting, sovereignty claims, and so on.

Canada is currently very active in establishing a presence in the high arctic, but the hostile climate and the vastness of the territory makes sustaining a human presence very difficult. POAs could provide constant unmanned patrol activity, with human pilots using the aircraft when more extensive, detailed monitoring is deemed appropriate. These aircraft could also be used as communications satellites in remote, or disaster zones, and the monitoring of pipelines is a natural application for a POA. Security and police functions could be conducted by aircraft of this type, using pilotless aircraft for long term monitoring and surveillance, as well as entering high-risk environments without the risk of personnel harm.

The big question, of course, for civilian use of POA or UAVs remains "When, if ever, will we see these aircraft used in a passenger carrying capacity?" There are many viewpoints and opinions surrounding this question. Some feel we will never have passengers flying in a pilotless aircraft. Then again, there was a time when people would only travel in elevators with an operator at the controls.

Most airports now feature fully automated, driverless, light rail vehicles. The notion of travelling in a train without an engineer would have been unthinkable a generation ago. Perhaps the day is not too far off when the crew member sits in the cockpit to monitor the automatic take off, then returns to the passenger cabin to serve drinks and headsets to the paying customers. After selling duty-free goods, they could return to the cockpit to watch the fully autonomous flight controls land the aircraft and taxi to the gate. We wait with bated breath.

Q: Why is inertial navigation preferred over GPS for unmanned aircraft?

Answer to previous question:

Q: Where is the circuitry for the crew call and ordinance sign "Chime Generator" located?
A: The chime generator circuitry is contained within the Passenger Address Amplifier.

GORDON WALKER *entered the avionics industry after graduation from Centennial College in 1980. His career with Nordair, Air Canada, CP Air, PWA, and ultimately Canadian Airlines took him to many remote corners of Canada. Since leaving the flight line to pursue a career as a college professor, Walker has continued to involve himself in the aviation/avionics industry, by serving on several CARAC Committees concerning the training and licensing of AMEs, being nominated to the CAMC Board of Directors, and being elected President of the National Training Association. (NTA).* ■