Case Study: Iris Automation's Casia SAA System Enabling BVLOS Flight

A fixed-wing VTOL drone (Censys Sentaero) equipped with Iris Automation's Casia *detect-and-avoid system. Casia's optical sensors (camera module visible in the nose) scan for aircraft while the onboard computer vision software identifies threats and initiates autonomous avoidance maneuvers.*

One real-world example of successful SAA deployment is **Iris Automation's "Casia" system**, which has been integrated on commercial drones to enable safe BVLOS operations. Casia is an **onboard computer vision detect-and-avoid (DAA) system** that acts as a high-tech lookout for the drone. It uses one or more cameras and a dedicated processor running machine learning algorithms to visually detect any aircraft in the drone's airspace. In extensive flight testing, this system proved capable of detecting intruder aircraft around **0.75 miles (1.2 km) away on average (up to ~1.2 miles max)**, providing enough warning for the drone to take action.

How it works: The Casia unit is typically mounted on the UAV (often on the nose or fuselage) and continuously scans the sky. Upon spotting another aircraft, the system's AI determines if that object is on a collision course. Impressively, it can classify the type of aircraft (distinguishing a light propeller plane vs. a jet vs. a helicopter) and estimate its speed and heading. This classification helps the drone decide how to evade – for example, an airliner moves fast and would require a more immediate avoidance maneuver than a slow crop duster. Once a threat is confirmed, Casia issues commands to the drone's autopilot to execute a pre-defined avoidance maneuver. In tests, the drone would often **initiate an automatic evasive action** (such as a quick descending spiral or lateral move) to get out of the intruder's flight path. All of this happens without human intervention, in real time. Casia essentially serves as an autonomous co-pilot that can take over to prevent a collision.

Crucially, Iris Automation not only focused on detection but also worked with regulators on the response logic. The system uses a "**dictionary of approved maneuvers**" – a set of safe avoidance actions vetted by authorities – and chooses an appropriate escape maneuver when needed. This aspect was *"critical to proving the system's safety to regulators"*, as the FAA wanted assurance that the drone's reactions would be predictable and effective. The hardware itself is compact (weighing on the order of a few hundred grams) and low-power, so it can be added to small industrial drones without much performance penalty. For cooperative aircraft, Casia can integrate ADS-B data as well, merging transponder information into its detection capabilities.

Real-world deployment – BVLOS powerline inspection: In 2019, Iris Automation's Casia was put to the test in a landmark project with the Kansas Department of Transportation (KDOT) UAS Integration Pilot Program. The goal was to inspect a 9-mile stretch of power transmission lines using a fixed-wing drone *without any human observers along the route*. This required special FAA approval, since at the time all BVLOS drone flights needed either observers or radar overwatch. KDOT's team (which included Kansas State University and utility company Evergy) equipped a long-range inspection drone with the Casia SAA system and developed a safety case for a fully autonomous mission. In November 2019, they successfully **completed this 9-mile BVLOS flight with no visual observers or ground radar**, a first under FAA Part 107 rules. The drone's onboard Casia system provided the required airspace surveillance and automatic collision avoidance during the flight. This meant the UAV could effectively "see" any oncoming aircraft and maneuver appropriately, just as a vigilant pilot would. The operation was conducted in coordination with air traffic control and adhered to a predefined route, but all immediate "sense and avoid" functions were handled by the autonomous system on the drone.

The outcome was a **historic milestone** for U.S. drone operations. According to the KDOT program release, it *"mark[ed] the first time under Part 107 the FAA has authorized an operation to fly BVLOS using only onboard detect-and-avoid systems"*. No chase planes, observers, or external sensors were needed, which demonstrated the viability of a self-contained SAA solution. The flights were completed successfully, proving that Casia could mitigate air-risk in a real utility inspection scenario. This gave Evergy and KDOT confidence that long linear infrastructure inspections could be done more efficiently with drones, since one drone and one pilot could cover miles of power lines without a whole team of ground spotters. Over a week of testing, multiple flights were flown, and no incidents occurred – the drone either did not encounter any conflicting aircraft or, if it did, Casia guided it to avoid them (the detailed encounter data from this trial was not publicly disclosed, but the system had already been validated in thousands of encounter simulations and flight tests prior).

Iris Automation's system had also been trialed in other pilot programs. Earlier in 2019, the University of Alaska carried out a 3.87-mile pipeline inspection flight using Casia, in that case supplemented by a network of eight ground-based radars for additional safety monitoring. These demonstrations provided valuable data. Iris reported that in three years of development testing (primarily in Nevada airspace), **Casia logged over 16,000 encounter events between drones and manned aircraft** without incident. Through these tests, the system kept improving its detection algorithms via machine learning (every flight's video data is recorded and fed back into training). The result is a mature SAA product that drone manufacturers (OEMs) can integrate into their UAVs. For instance,

Censys Technologies, maker of the Sentaero BVLOS drone (shown above), offers Casia as an integrated option on their aircraft to customers who need an approved DAA capability.

Regulatory Impact and Industry Outcomes

The successful deployment of an SAA system like Casia in Kansas had immediate and long-term regulatory significance. In the immediate term, the FAA's waiver for the KDOT project was *"the first of its kind"* – it essentially validated that an onboard collision avoidance system could substitute for the eyes of a human observer. This set an important precedent: other companies could now build on that safety case to obtain similar waivers, accelerating BVLOS operations. In fact, following this milestone, multiple organizations sought FAA waivers citing similar technology. Companies conducting railroad inspections, pipeline monitoring, and even drone delivery trials have since leveraged SAA systems (from Iris Automation and others) to argue for safe BVLOS flight corridors.

On a broader scale, these case studies have informed rulemaking. The FAA launched a **Beyond Visual Line of Sight Aviation Rulemaking Committee (ARC)** and is working toward new regulations (sometimes referred to as a future Part 108) to normalize BVLOS drone operations. Data from projects like the KDOT/Iris demo feeds into performance standards for detect-and-avoid. Regulators have indicated that a **360° field of view** will likely be required for true autonomous airspace integration. This means SAA solutions must cover all directions around the drone (which can be achieved by multiple cameras or sensors on different sides). Already, the Casia system can be scaled up with five or six cameras to achieve 360° coverage, and other manufacturers are developing equivalent multi-sensor packages. The FAA is also evaluating technologies like airborne radar and ACAS X (Airborne Collision Avoidance System for Unmanned Aircraft) in parallel, which could complement vision-based SAA.

Importantly, the Kansas demonstration and others proved to regulators that autonomous SAA can be done in a reliable way. Iris Automation's CEO noted that the **FAA was convinced to trust the drone's "eyes"** in new areas much like they trust a human pilot's eyes. This trust is being reflected in recent waivers: for example, American Robotics, a drone-in-a-box provider, received a broad FAA waiver allowing fully autonomous BVLOS operations with no observers, after demonstrating a robust onboard safety system (combining sensors and procedural mitigations). Each success reduces the dependence on case-by-case waivers and moves the industry closer to routine rules for unmanned flight beyond sight.

From a global perspective, regulatory bodies in other countries (Canada, Australia, EU's EASA, etc.) are watching these developments closely. Many have their own trials of SAA-

equipped drones. Some large UAVs (like the General Atomics SkyGuardian) have even integrated radar, ADS-B, and traffic alert systems to meet manned-aircraft-equivalent collision avoidance standards for high-altitude airspace. But for **small commercial drones**, the Kansas case study stands out as a breakthrough demonstrating that even a ~20 lb electric drone can independently detect and avoid a piloted aircraft, satisfying regulators and operating safely. It opened the door for infrastructure companies and drone service providers to start scaling up operations like never before.

Conclusion

Sense-and-avoid systems are a linchpin for the future of commercial drone operations. By combining sensors (from ADS-B receivers to vision and radar) with intelligent software, modern UAVs can achieve a level of situational awareness that approaches, or in some aspects even exceeds, human capability. The case of Iris Automation's Casia system enabling a fully autonomous BVLOS powerline inspection flight in Kansas demonstrated that effective SAA technology can unlock missions that were previously off-limits under aviation rules. The drone in this case study was able to autonomously detect a potential airborne collision risk and take evasive action – all without a human in the loop – and it earned the FAA's confidence to do so. The outcome is **safer skies and expanded opportunities**: utilities can inspect critical infrastructure more frequently, logistic companies can envision longer delivery routes, and overall the drone industry can scale beyond the line-of-sight of a single pilot.

As regulations evolve, we can expect SAA requirements to become standard for advanced drone operations. The technology stack will continue to be refined – with multi-sensor fusion, better algorithms, and perhaps vehicle-to-vehicle communication (so drones and airplanes share intent). The ongoing case studies and deployments are not just isolated achievements; they are building the safety case and **technological foundation for mainstream autonomous flight**. In summary, the implementation of SAA in commercial UAVs, exemplified by the BVLOS flights powered by Casia, shows that drones can indeed fly safely alongside manned aircraft when equipped with the right "digital sense and avoid" capabilities. Each successful deployment brings us one step closer to routine autonomous drone operations in national airspace, with SAA systems as the enabling cornerstone.