Synopsis of Lecture to RAeS Loughborough Branch on 22 March 2011

UAV Systems: Breakthroughs and Hurdles by Dr Arthur Richards, Bristol University

UAVs are systems; the vehicle is only a small part of the overall system. Part of a UAV is its pilot who happens to be located elsewhere rather than in the vehicle cockpit as is the case with a manned aircraft. UAVs are defined in terms of their capabilities or functions: mission(s), payload and take-off mode. They are unmanned because of the nature of the functions which they are required to undertake. These functions are often Dull, Dirty and Dangerous: Dull because UAVs are required to loiter for long periods; Dirty because they can be used in environments which can contain chemical and/or radiation hazards; Dangerous because they carry out reconnaissance over enemy territory.

The position of a UAV must be accurately known at all times otherwise its usefulness is severely limited. For many years their endurance was limited by the drift in positional accuracy over time. The onset of navigation aids such as GPS has removed this problem such that the only remaining problem is equipment reliability. Endurance is now recognised as the prime attribute of UAVs.

Typical relatively small UAVs are often used for gathering “pattern of life” intelligence over many hours, typically 40 hours at a time. This facility cannot be provided by low earth orbit satellites which circle the earth and therefore do not provide immediate responsiveness. Neither is it possible to use geo-stationery satellites unless a “basket” of such satellites is available to cover the globe. Also their orbit positions them much further above the earth than a UAV which degrades the resolution of any images they obtain.

UAVs can be of similar dimensions to manned aircraft, e.g. Predator A UAV 15 m span, F-16 aircraft 10 m span. There is however a significant difference in their velocities; Predator A 80 knots, F-16 1300 knots. The former is ideal for loitering and reconnaissance.

Unlike manned aircraft, UAVs often incorporate a V tail rather than a conventional one. This saves 28% in tail weight but has a complex pitch and role control relationship which requires a full fly-by-wire control system.

UAVs are not new; the first UAV was the Sperry torpedo biplane of WW1 and there was the V1 criuse missile of WW2. Later examples included the Jindivik aerial gunnery target, the Ryan Firebee observation UAV as used in Vietnam and the R-Max crop spraying helicopter use in Japan. Note that the Firebee had to be recovered and the film it carried printed before the intelligence data was available. Modern UAVs such as Predator A provide real time intelligence data via a video communications link back to a ground based control station. Whilst Predator A was intended for reconnaissance, Predator B has now been developed as both a reconnaissance UAV and a missile/weapon carrier.

UAVs have also been developed for civil applications such as the thermal imager based microdome UAV used by the West Midlands Fire Service to conduct risk assessments for fighting fires.

However UAVs are still not commercially competitive when compared with cheap commercial aircraft.

The importance of UAVs for military applications can be seen from the fact that the US had 167 UAVs in military use in 2003 but this has now risen to 5331. The significance of UAVs is also illustrated by the fact that “users are having to wait for up to an hour” for information obtained by UAVs to be acted upon by a manned aircraft strike. The current limitation on using UAVs is the bandwidth limit associated with the video data transfer to ground stations.

There is no standard certification route for UAVs. In general terms they “must be as safe as manual aviation”. This is almost impossible to prove.