HoistEM

HoistEM is a helicopter-towed time domain electromagnetic system.

In order for a time domain electromagnetic system to be effective the transmitter must be as large as possible. The current HoistEM system consists of a 24 mtr diameter loop of bare stranded aluminium conductor (Figure 1). To support this loop in flight a Hoist using commercially available windsurfer masts and specially fabricated carbon fibre/kevlar components is used (Figure 2).

The Hoist uses high drag to ensure flying stability and direction. The design survey speed is 45 knots airspeed and the Hoist is tested to 60 knots to give a safety factor for unexpected turbulence.

Figure 1.

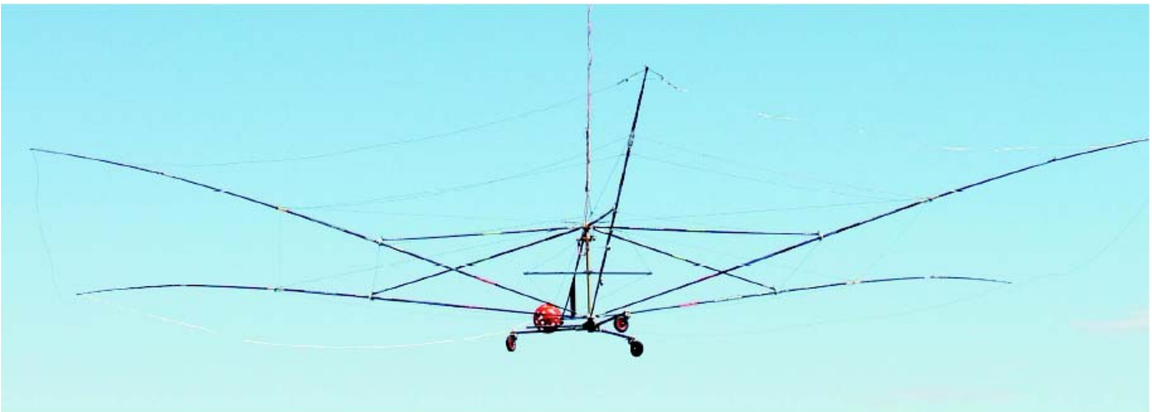


Figure 2.

INSTRUMENTATION IN THE HELICOPTER

The transmitter that generates the electromagnetic pulse is attached to the floor behind the pilot. This transmitter produces a five millisecond pulse of approximately 340 amps which is routed down to the Hoist via heavy-duty copper welding cables. This pulse has a very rapid switch off of 40 microseconds. The transmitter waveform is shown in Figure 4.

After initial switch-on no instrumentation in the helicopter requires operator intervention until the end of the flight. The pilot is capable of switching the equipment on and off, eliminating the need for an operator in the aircraft.

Figure 3. Transmitter, Receiver and Power Supply

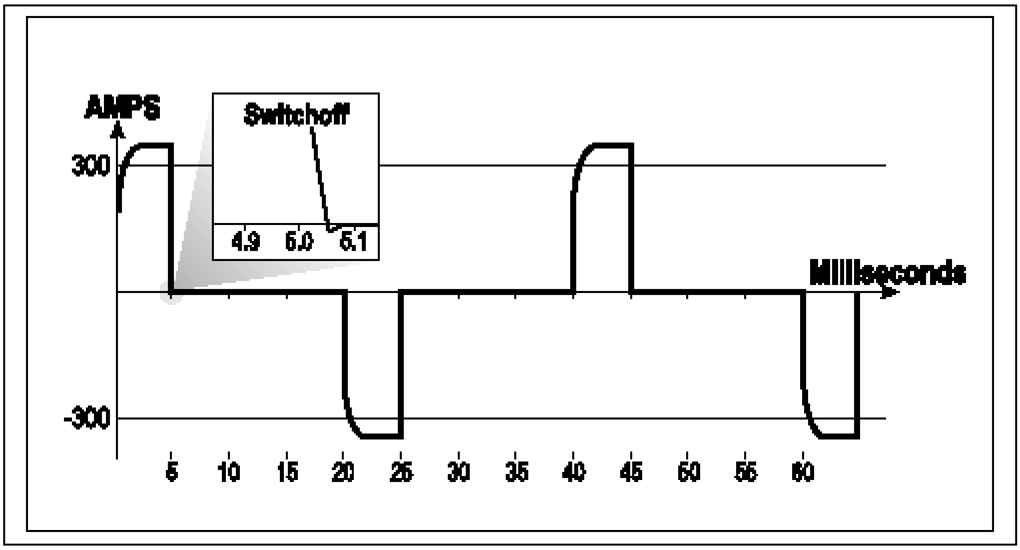


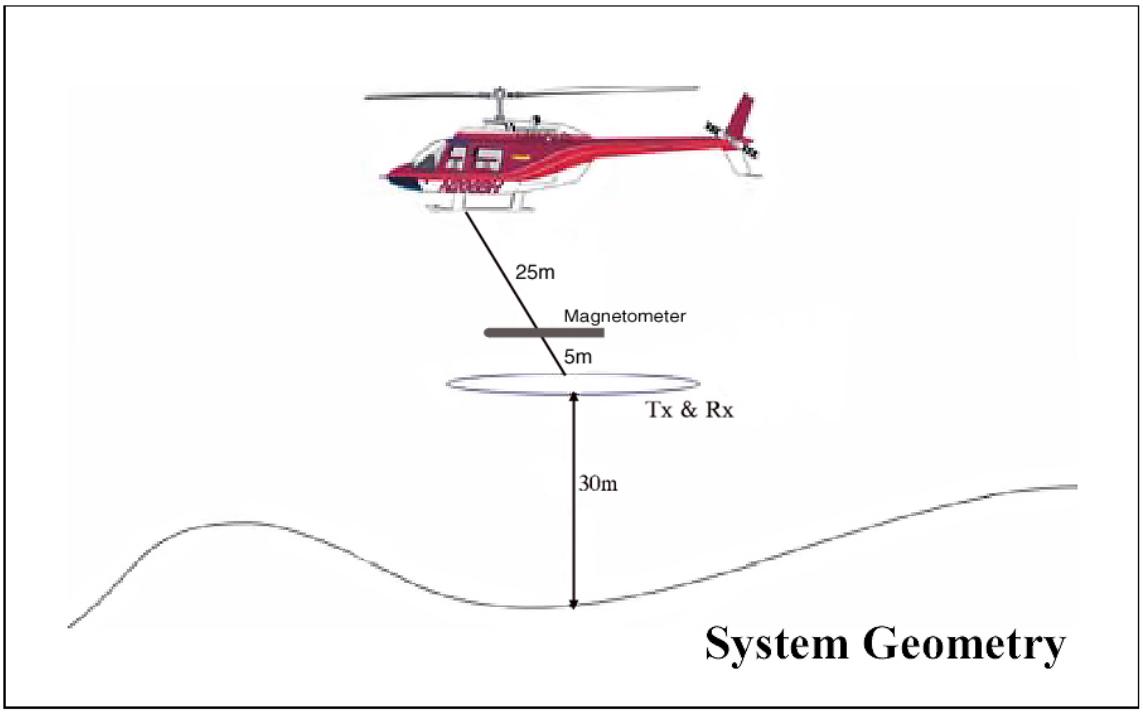
Figure 4. Transmitter Pulse

HoistEM RECEIVER

In any EM system the receive loop is a critical component.

All noise sources that the receive loop picks up degrade the signal from the ground. Most airborne EM systems use a towed bird to house the receive loop(s). The major source of noise is the motion of the receive loop through the earth's magnetic field.

HoistEM uses a multi-turn receive loop that is directly attached to the Hoist. This uses the inertia of the Hoist to restrain the movement of the receive loop and minimise the effect of the receive loop moving through the earth's magnetic field. A particular problem with airborne receiver coils is microphonic buffeting. This buffeting occurs because of the size of the towed bird and the speed it is towed at. The buffeting causes significant noise in the receive coil. By using a small diameter coaxial cable for the receive loop and attaching it directly to the Hoist this buffeting is eliminated.
There is a further advantage gained by having the receive loop attached to the Hoist - the system has a true 'in loop' geometry. Also a large receive loop moment with a very high bandwidth is easily obtained.



HoistEM PROCESSING

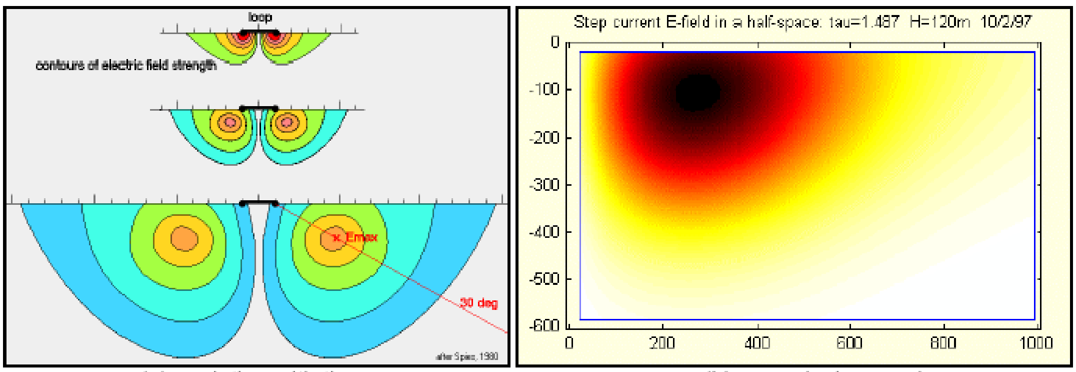
HoistEM can be processed with a range of commercially available software.

EmaxAIR is our preferred first pass. (EM Flow is also commonly applied).

EmaxAIR calculates conductivity versus depth pseudo section data from the transient electromagnetic (TEM) voltage response data of various airborne EM systems. Conductivity-depth pseudo sections are a convenient form of presentation of EM profiles for first-pass interpretation. A number of schemes have been devised for conductivity-depth imaging (CDI) of airborne EM data. EmaxAIR uses an adaptation of a maximum current (Emax) algorithm applied to airborne TEM data. The method was originally developed for coincident loop and in-loop ground TEM by Fullagar (1989), and later extended to fixed loop and slingram TEM by Fullagar & Reid (1992) and Reid & Fullagar (1998).

The Emax transformation proceeds in two stages: off-time data are first converted to apparent conductivity, and the depth assigned to each delay time is the depth of the induced current maximum in a half-space with conductivity equal to the apparent conductivity at that time.

In the context of depth conversion methods it is easy to confuse *physical* currents and *image* currents. A physical current ("smoke ring") is the real flow of charge carriers in the ground; an image current ("current filament") is a mathematical abstraction, which replicates the magnetic field on the surface. The physical current maximum, **|E|**max, travels down into a half-space along a straight-line path at an angle of approximately 30°, whereas the image current filament travels in a similar manner but more steeply at about 47°. This is so because the "equivalent current filament" which has an infinite current density must always be deeper than the maximum of the actual distributed current system. The consequence of this is that depth conversion methods based on image currents will inherently over-estimate penetration depths. The depth conversion method used in EmaxAIR pertains to physical currents.



(a) evolution with time (b) numerical example

Figure 1 - Secondary physical currents

The advantage of the Emax transformation is that, given its reliance on apparent conductivity, it is readily adaptable to a wide variety of TEM data. The disadvantage is that apparent conductivity is not unique, nor always defined. In practice the non-uniqueness rarely poses difficulties for transformation of airborne EM because the alternative apparent conductivity is usually too extreme to be considered geologically plausible. The purpose of EmaxAIR conductivity-depth processing is to quickly and reliably transform raw data into a useful form for presentation of conductivity at a true depth scale, and to allow for a fast initial interpretation of the data.

HoistEM SPECIFICATIONS

Parameter	HOISTEM
Loop Area:	375 m^2
TX Current:	320 amps
TX Moment:	120,000
TX Waveform:	25% bipolar – Square Wave
TX Fall Time:	40 usec
Pulse On Time:	5 millisec
Height Measurement:	Laser 10Hz
Digital GPS:	Proprietary
Pilot Guidance:	Proprietary
Power Source:	6KVA Alt.
Flying Speed:	45 knots
Loop Flying Height:	40 metres
Sling Length:	35 metres
All-up Weight:	380 kg
RX Dynamic Range:	120dB +/- 2.5uv to +/- 1.2V
RX op Time:	50usec to 13 msec
Platform:	Squirrel BA 350