

Letters to the Editor

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DUCT PROPAGATION OF V.H.F. SIGNALS OVER ARABIAN SEA

1. Temperature inversion layers existing within a few hundreds of metres above the sea water are known to act as good ducts for propagation of V.H.F. radio waves. Due to this waveguide effect, the signals of radar and other V.H.F. transmitters, sometimes, reach distances of more than one thousand kilometres. The trans-horizon propagation provided by these channels have not, however, been utilised earlier for routine V.H.F. transmissions as the refracting properties of these ducts are not very consistent. Current work in this field has shown that though the height and refractive index of the ducts vary significantly even within a few hours these ducts are never completely absent. And these channels can hence be employed for round-the-clock operation, provided the transmitters have reasonably good power, the receivers are of the low-noise type and the angle of radiation is adjustable to suit the height of the temperature inversion layer.

2. The Oil and Natural Gas Commission had conducted a seismic survey during the months of January and February of 1971 in the off-shore areas near Bombay and a foreign company was hired for fixing the position of the survey ship through Shoran Navigation System employing duct propagation. Though this type of radio-navigation surveys is not exactly new in other parts of the world, the details of the same are given here as a possible source of information for those who might not have come across this mode of propagation for routine operations.

3. Radio positioning units of the Shoran type employ the principle of radar to find the distance of the ship to two known stations and then locate the position by drawing suitable arcs. The V.H.F. signals of 250 MHz employed for this purpose do not reach points beyond the line-of-sight when space-waves alone are used and due to this limitation, the range of these transmitters is rarely greater than 50 km.

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The improved version of Shoran which utilizes the duct-mode is called XR-Shoran (for extended range) and it has a consistent round-the-clock operational range of more than 250 km. The height of the aerials in these units is around 15 m. The formula for computing the space wave coverage of V.H.F. radiations when the transmitter has sufficient power is

$$d = k(\sqrt{h_1} + \sqrt{h_2})$$

where, d is the range in miles, h_1 and h_2 are the heights of the transmitter and receiver respectively in feet and k is a constant whose value ranges from 1.2 to 2.0. According to this formula the maximum line-of-sight coverage for the conventional Shoran transmitters with 15-metre aerials should be less than fifty kilometres.

4. In the seismic survey carried out in the Arabian Sea, the two base stations were located along the coast at a distance of 100 kilometres from each other and each station had a transponder for actively reflecting the incident signal back to the receiver in the ship. The transmitters and receivers were part of the surplus Shoran equipment manufactured by Radio Corporation of America for military purposes around 1955 and the original units were employed for automatic guidance of the bomber planes. In extending the range of these Shoran units, the signal to noise ratio as well as the gain of the receivers were improved and the antennas were also mounted in such a way that they were more easily steerable. The transmitted pulses had a duration of one micro-second and the peak power of these signals was 12 kilowatts. The average power was, however, only a few watts. This system was able to receive echoes from distances of more than 200 km, with 15 m high aerials, and throughout the two months long survey there was no difficulty in getting reflections during the day as well as the night. The location of the ship as indicated by Shoran was correct to ± 15 m at the extremities of the survey area and this accuracy was better than what would have been available through normal ground-surveys.

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REFERENCE

- Tropospheric Refraction in *Propagation of short Radio Waves*, Radiation Lab. Series Vol. 13.