limitations as those using visible wavelengths, such as the inescapable trade-off between magnification and field of view.

When we come to radar, the wavelengths exceed those of visible light by factors of hundreds of thousands, and the lens is replaced by the antenna. However the basic principles of resolution and field of view still apply. Because radar sends out its own pulses of energy, which are reflected from its targets, instead of simply receiving energy scattered from solar radiation, it is able to measure distance as well as determine direction, and by using very short pulses or clever coding of long pulses, can achieve good resolution in range. However, because it is not practical to construct antennas hundreds of thousands of times as large as optical lenses, the angular resolution achieved by conventional radar is much inferior to what can be accomplished by optical surveillance. In addition, since the angular beamwidth spreads with increasing distance from the antenna, the resolution degrades with range. In order to make the resolution in direction comparable to what can be achieved in range (say 10 metres)[24] the antenna on an aircraft would have to be about one kilometre long for observation of targets 100 km to one side of the aircraft. For a surveillance satellite the length of the antenna would have to be 4 km. Fortunately, modern techniques of storing and processing data are now enabling the signals received by a moving antenna of easily achievable dimensions to be collected and combined over a period of several seconds, in order to synthesize an image corresponding to what could have been produced by a stationary antenna that was as long as the distance moved by the smaller one during the several second period. This very important technique, known as Synthetic Aperture Radar (SAR), can be applied to aircraft or satellites, but requires advanced signal processing equipment. A brief description of the principles governing synthetic aperture radar is given in Annex B.[25]

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[24] This would require a pulse length of 0.067 millionths of a second.

[25] S.A. Hovanessian, *Introduction to Synthetic Array and Imaging Radars*, Dedham, MA: Artech House, 1980. This book provides a good introduction to synthetic aperture radar, as does *Introduction to Airborne Radar*, op. cit.