Analysis of complex shape targets by natural poles of resonance. Determination of characteristic dimensions.

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In resonance domain, the radar scattering response of any object can be modeled by its natural poles of resonance, with the formalism of the Singularity Expansion Method (C.E. Baum, *in Transient Electromagnetic Fields*, L.B. Felsen, Ed., New York: Springer-Verlag, 1976, pp 129-179). The mapping of poles gives useful information in order to discriminate radar targets. In this paper, we propose to show how these poles of resonance enable us to determine characteristic dimensions of targets.

Resonances occurring at particular frequencies are induced as well by external creeping waves as by internal cavity waves. For a perfectly conducting target, where only external resonances exist, characteristic dimensions can be easily determined from corresponding poles of resonance.
For canonical targets (sphere, cylinder …), poles of resonance are distributed over branches. In a homogeneous medium, the view angle has no influence on the position of poles in the complex plane, but only acts on their residues. We have shown (J. Chauveau *et al.*, EuMW/Eurad, Paris, 2005, pp 69-72) that a reduced number of such poles is sufficient to characterize an object: the dominant pole, corresponding to the fundamental pulsation of resonance (ω_d), and some harmonic poles (2 or 3). In fact, ω_d allows to calculate the perimeter (characteristic dimension) of the target.
Furthermore, a true – complex shape – target can often be modeled by a combination of canonical objects (Fig. 1). Indeed, poles of resonance are distributed over distinct branches (Fig. 2), each one being associated to the corresponding canonical object. We will explain how the perimeter of each elementary component of the target is related to its corresponding ω_d, for several shapes of targets.

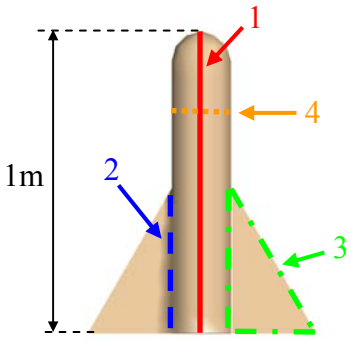

Fig. 1 : target = assembly of cylinder, half-sphere and two triangular wings

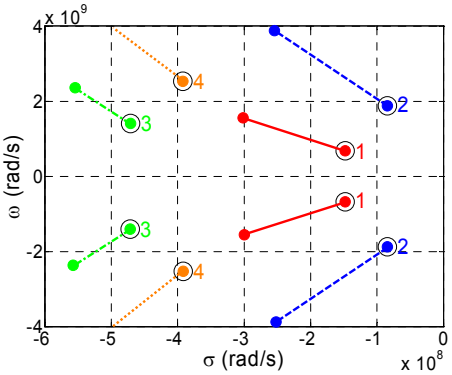

Fig. 2: mapping of poles in complex plane
Circled: dominant pole of each branch