PROCEEDINGS OF THE 1997 IEICE GENERAL CONFERENCE

1997年総合大会講演論文集

エレクトロニクス 1

一般講演

C-1. 電磁界理論 C-3. 光エレクトロニクス

C-2. マイクロ波 A. B. C C-4. レーザ・ 量子エレクトロニクス

シノボジウム

SC-1. 導波路における波動結合とその応用デバイス

SC-2. マイクロ波・ミリ波帯における最近の材料定数測定技術の進展とその応用

SC-3. 光テジィス・光回路の集積化・モジュール化技術

SC-4. テラビット伝送を可能にする光デジィス・光回路

ソサイエティ企画

プレナリーセッション

バ ネ ル 討 論 PC-1. 通信用フェーズドアレーアンテナのマイクロ波技術

パ ネ ル 討 論 PC-2. マイクロ波・ミリ波技術におけるシミュレータの役割

パネル討論 PC-3. 光波ネットワークとこれを支えるキーデッドイス技術は何か

チュートリアル講演 TC-1. マルチビーム空間電力合成のための基本技術

チュートリアル講演 TC-2. 最近のマイクロ波受動回路構成技術

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Analytical-Numerical Approach for the Solution of the Diffraction by a Thin Dielectric Strip

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Approximate boundary conditions are often used to simplify analytical and numerical solutions of scattering problems involving complicated structures. The simplest comditions are the standard impedance boundary conditions applicable at the surface of a lossy dielectric and the re- obtained by Volakis [3] to enable comparison. It is seen lated transition conditions modeling a thin dielectric layer from Fig. 3 that our RCS results based on the analyticalas a current sheet. Recently it was suggested by Senior and Volakis [1] that a thin dielectric layer can be effec- presented in [3]. tively modeled by a pair of modified resistive and conductive sheets each satisfying given boundary conditions. In this paper, we shall consider the model of a thin dielectric strip formed by the combination sheets and analyze the Hpolarized plane wave diffraction by means of the analyticalnumerical approach [2].

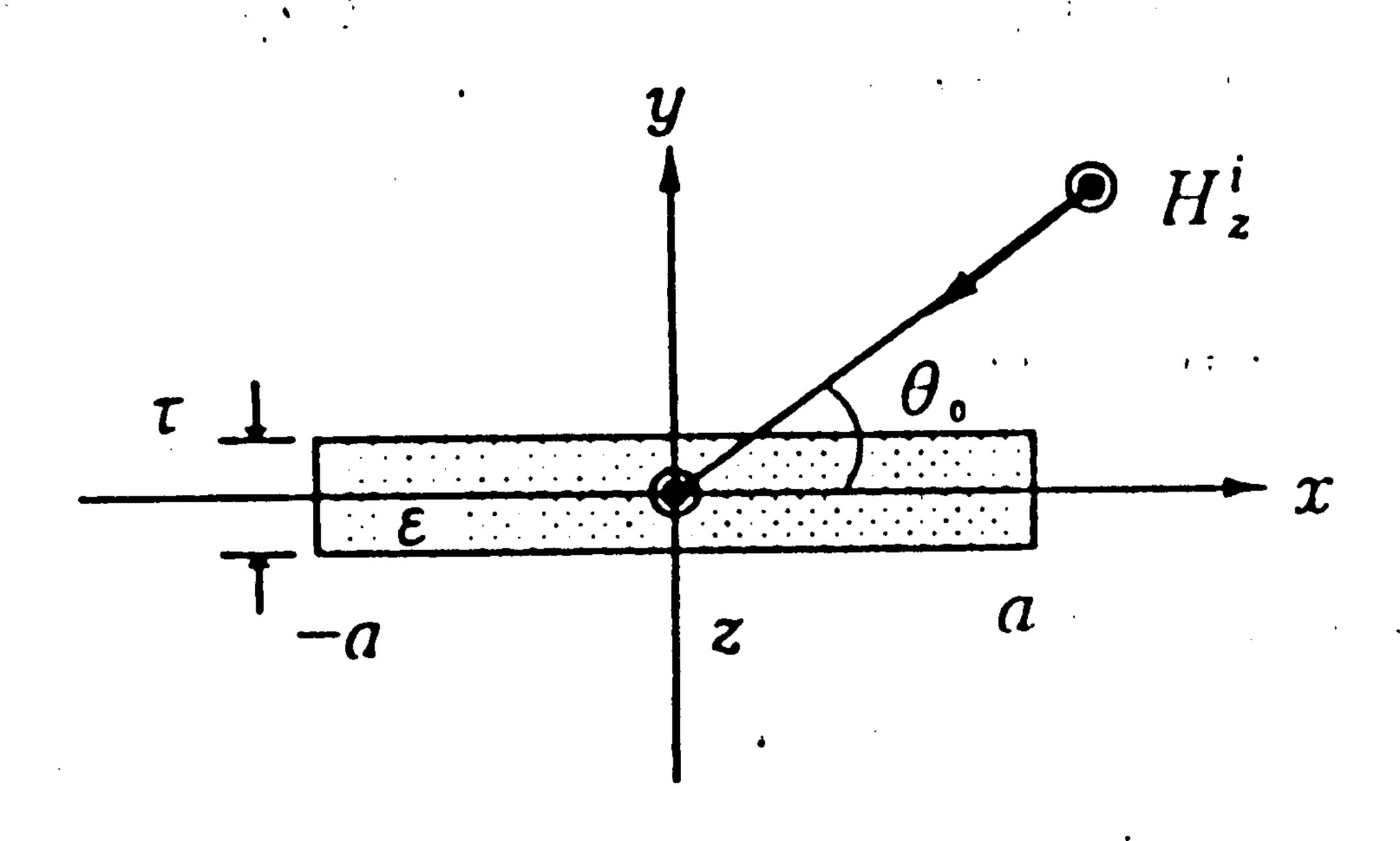


Fig.1. Geometry of the problem.

The geometry of the dielectric strip is shown in Fig. 1, where $H_z^i = e^{-ik(x\cos\theta_0 + y\sin\theta_0)}$ is the incident field of Hpolarization with k being the free-space wavenumber. On the surface of the strip, the total field satisfies the boundary condition of coincident resistive and modified conductive sheets. as given by [1]

$$E_{z}(x,+0) + E_{z}(x,-0) = 2R \left[H_{z}(x,+0) - H_{z}(x,-0) \right], (1)$$

$$\left(1 + \frac{1}{k^{2}} \frac{\partial^{2}}{\partial y^{2}} \right) \left[H_{z}(x,+0) + H_{z}(x,-0) \right]$$

$$= 2R^{*} \left[E_{z}(x,+0) - E_{z}(x,-0) \right]$$
(2)

with $R/Z = i/[k\tau(\varepsilon-1)].$ $R^*Z = i\varepsilon/[k\tau(\varepsilon-1)],$ where τ , ϵ , and Z are the thickness of the strip, the relative permittivity, and the intrinsic impedance of free space, respectively. Applying the above boundary condition to an integral representation of the scattered field, the problem is formulated as two integral equations satisfied by the unknown current density functions. Expanding the current density functions in terms of the Gegenbauer polynomials by taking into account the edge condition, our problem is reduced to the solution of two infinite systems of linear algebraic equations (SLAE) satisfied by the unknown expansion coefficients. These coefficients are determined numerically with high accuracy via truncation of the SLAE. The scattered field is evaluated asymptotically and a far field expression is derived.

Figures 2 and 3 illustrate the normalized monostatic radar cross section (RCS) as a function of incidence angle for $2a = 4\lambda$ and 2λ , respectively, where λ is the free-space wavelength. In Fig. 3, we have also plotted the results numerical approach agree reasonably well with the results

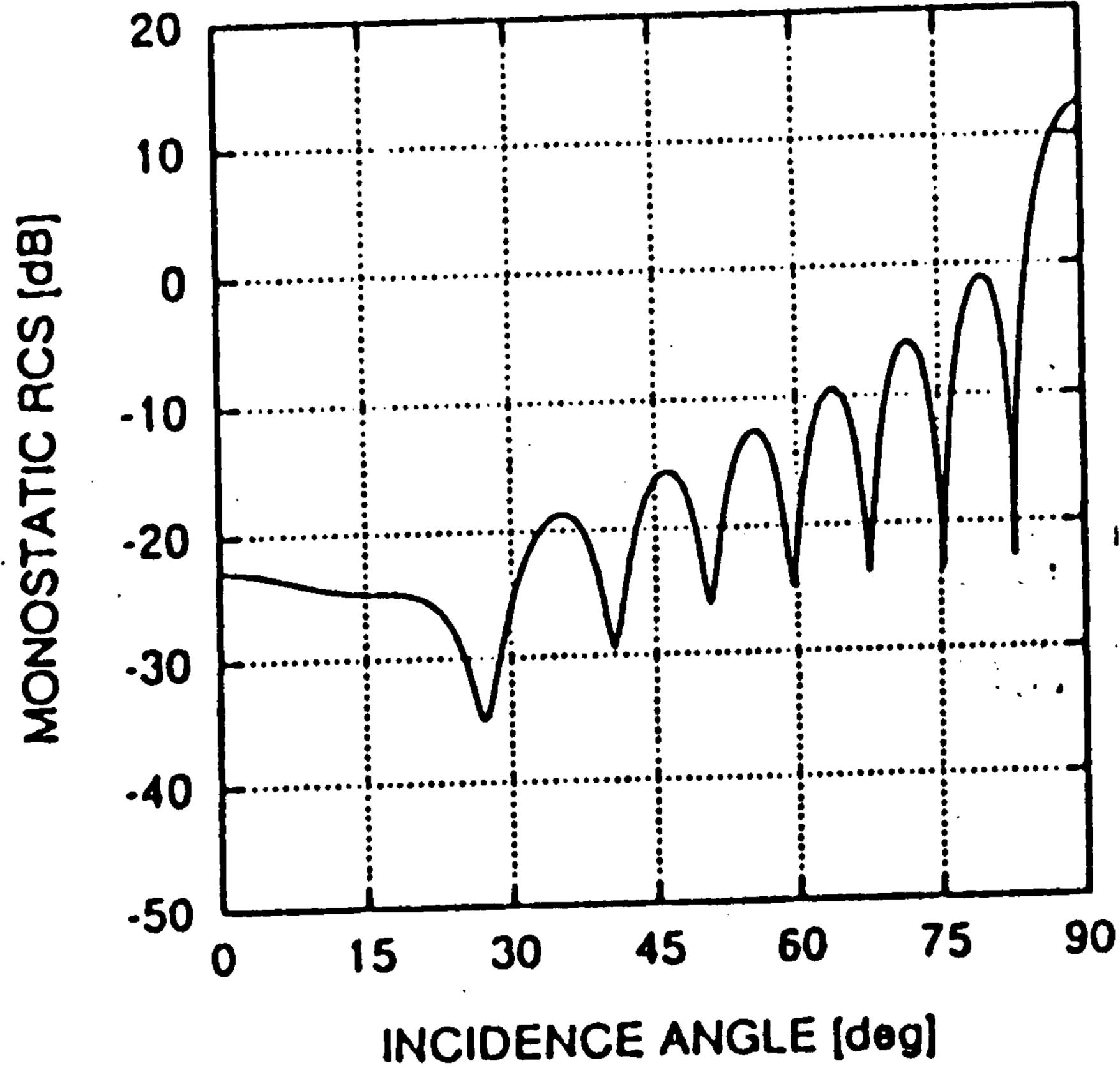


Fig.2. Monostatic RCS versus incidence angle for $2a = 4\lambda$, $k\tau = 0.314, \, \varepsilon = 4.0.$

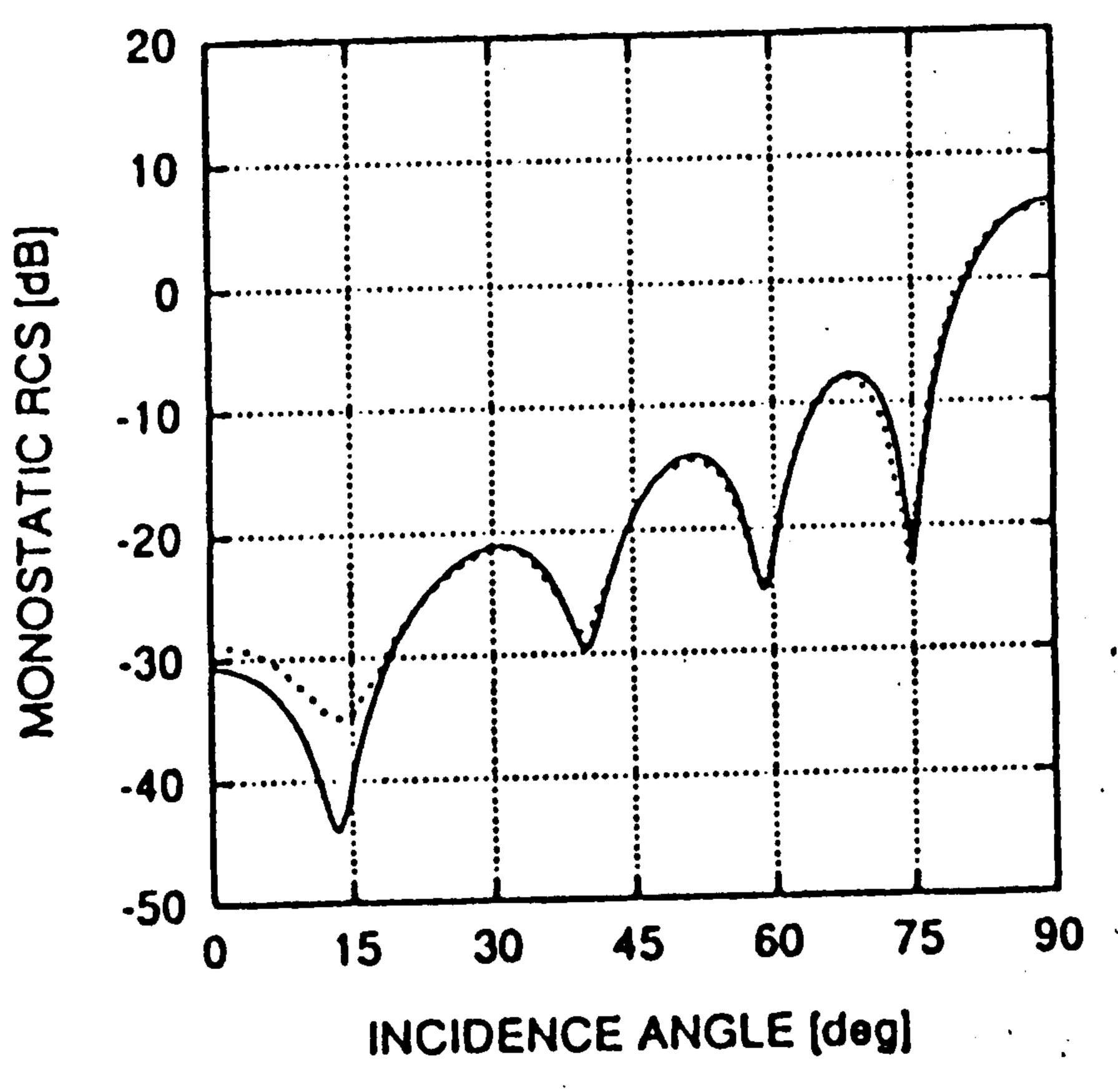


Fig.3. Monostatic RCS versus incidence angle for $2a = 2\lambda$, $k\tau = 0.314$, $\varepsilon = 4.0$ and its comparison with Volakis [3]. ---: this paper, ····: Volakis [3].

Acknowledgment

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