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Letter to the Editor

Comments on “Basic properties of Rayleigh surface wave propagation along curved surfaces”, by F. Jin, Z. Wang, K. Kishimoto, International Journal of Engineering Science, 43 (2005) 250–261

Abstract

In this ‘Letter to the Editor’, it is demonstrated that the main results obtained in the work “Basic properties of Rayleigh surface wave propagation along curved surfaces”, by F. Jin, Z. Wang, K. Kishimoto, International Journal of Engineering Science, 43 (2005) 250–261, have been established ten years earlier.

In the above-mentioned work of Jin et al (2005), the authors claim that their results are novel. However, this is incorrect, as discussed below.

In the Introduction and in the main sections of the mentioned work, the authors refer to our book (1995), where Chapter 9 and part of Chapter 10 discuss Rayleigh wave propagation along curved surfaces of arbitrary shape. They state (Page 251) that in this book “some terms in the equations are omitted for simplification, and only the influence of curvature radius in the plane along propagation direction on the propagation behaviour is considered.” On that basis, they conclude that “for the case of wave propagating along the direction that the curvature radius is infinite (for example, along generatrix direction of a circular cylinder), unreasonable results will be obtained [from our book – VVK] that there is no any difference between the wave equation of Rayleigh wave along a curved surface and a plane surface, respectively.”

However, the above statement is incorrect. Although some smaller terms in the governing equations used in our book have been neglected, resulting in disappearance of the surface radius of curvature in the direction perpendicular to the direction of wave propagation from the simplified equations, this radius of curvature re-appears in the boundary conditions on a free curved surface that contain both radii of curvature. As a result, both these radii are present in the expression for Rayleigh wave velocity c (see Eqn (9.2.12) of the book):

$$c = c_0(1 + \eta), \quad \eta = a_u \frac{1}{k_0 \rho_u} + a_v \frac{1}{k_0 \rho_v}, \quad (1)$$

where c_0 is the Rayleigh wave velocity on a plane surface, $k_0 = \omega/c_0$ is the corresponding wave number, ρ_u and ρ_v are the radii of the surface curvature in the direction of wave propagation and in the direction perpendicular to it, respectively, a_u and a_v are the non-

dimensional coefficients that depend on Poisson's ratio and can be expressed via the other non-dimensional coefficients A, B, G as $a_u = -(A/2B)$ and $a_v = -(G/2B)$.

Formula (1) reflects the dependence of Rayleigh wave velocity on both radii of curvature. Note that the authors' own result (see their Eqn (24)) has similar form:

$$c = c_R(1 + \delta_c), \quad \delta_c = -\frac{1}{2} \frac{1}{k_0 C'} \left(\frac{A'}{\rho_\alpha} + \frac{B'}{\rho_\beta} \right). \quad (2)$$

The notations $c_R, \delta_c, k_0, \rho_\alpha, \rho_\beta$ and A', C', B' in Eqn (2) have the same meaning as $c_0, \eta, k_0, \rho_u, \rho_v$ and A, B, G in Eqn (1), respectively. Note that the authors derived their results (Eqn (2)) from the full (non-simplified) governing equations given in the mentioned book (Eqn (9.2.4)).

Although the algebraic expressions for A', C', B' in Eqn (2) are different from those for A, B, G in Eqn (1) (due to the different approximations used), the numerical calculations of η and δ_c lead to the same physical conclusions. Namely, the effect of surface curvature in the direction of Rayleigh wave propagation increases the Rayleigh wave velocity, whereas the effect of surface curvature in the perpendicular direction decreases it. These effects of both radii of curvature on Rayleigh wave velocity are clearly stated in our book (Page 202, for example). Moreover, the importance of the effect of surface curvature in the perpendicular direction as a cause of Rayleigh wave velocity reduction, resulting in the emergence of wave turning points in case of variable curvature and in the possibility of waveguide propagation of Rayleigh waves, is emphasised several times in Chapters 9 and 10 of our book in connection with Rayleigh wave propagation in the so-called 'smooth topographic waveguides'. The description of all these effects would have been impossible if, as the authors say, the effect of curvature in the perpendicular direction was not taken into account in our work.

Let us now consider the main conclusions that Jin et al (2005) draw from their Eqn (2). In particular, they conclude that when a Rayleigh wave propagates along a surface of a convex cylinder in the direction perpendicular to its generator then “the wave velocity is faster than that of the corresponding wave along a plane surface”, and if a Rayleigh wave propagates along a generator of a convex cylinder the velocity becomes slower. Both these facts are described in Section 9.3 of our book. Further, Jin et al (2005) state that there is a direction of Rayleigh wave propagation on a cylinder for which “it is easy to obtain $\delta_c = 0$, this result means on condition that the curvature radii of curved surface are satisfied with above relation, the Rayleigh wave propagates along a direction with the same phase velocity as the wave along a plane surface.” This fact has also been established in our book (Pages 204-205). Thus, claims of Jin et al (2005) to novelty of their results are incorrect.

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