EXTREMAL INVERSION OF LUNAR TRAVEL TIME DATA, Norm Burkhard and David D. Jackson, Univ. California, Los Angeles, California 90024.

Analysis of recent lunar seismic travel time data from distant meteoroid impacts, high frequency teleseismic events, and deep moonquakes has been performed by Nakamura et al. (1). Their inversion results in a velocity structure for the moon upon which a lunar model is then partially based. To test the uniqueness of their velocity structure, the tau method of inversion of travel times developed by Bessonova et al. (2) was applied to the Nakamura data along with some of the Apollo impact data.

The tau method of inversion determines the limits for velocity-depth curves from discrete travel-time data. The method involves an estimation of the function tau

\[ \tau = T - px \]

from a Clairaut equation followed by an integration of tau with appropriate weighting functions.

The P wave travel time uncertainties for Nakamura data were assumed to be 2 seconds while the computed distances were taken to be exact. Although subjective judgment entered the inversion process in the estimation of the function tau, the final results are valid if velocity structures computed generate travel time curves that agree with the real data.

The velocity depth limit curves (Fig. 1) show that the range of possible seismic velocity models is considerably larger than that given by Nakamura. All velocity-depth structure consistent with the data must be included between the limiting lines, but not all structures included within the boundaries agree with the data.

Several velocity models, selected almost at random from within the bounds, are in excellent agreement with the travel time data. A typical example, rather different from previously published models, is shown in Figure 1. While we do not necessarily advocate this as a realistic lunar model, it does fit the travel time data rather well. While amplitude data will further restrict the models, we feel it is important to consider first the widest possible class of models consistent with travel time data. The tau method is well suited to explore these models.
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References


Figure Caption

Figure 1: Outer curves are limits on velocity-depth profiles from this work; central dark band is approximate range of Nakamura's velocity profiles; inner curve is hypothetical model which fits lunar travel time data.
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