# STRAIGHTEDGE DETERMINATION OF INTERVAL VELOCITY

*Jon F. Claerbout*

Simple slope measurements on a common midpoint gather can be used to compute interval velocity. The advantage of measuring interval velocity in this way is that the question of accuracy in relation to data quality is easy to visualize. From *How to Measure RMS Velocity with a Pencil and a Straightedge*, SEP 11 p. 41-43 equations (5) and (7) we have

$$p = \frac{\partial t}{\partial f} \tag{1a}$$

$$F = p \int_0^T v^2 \, dt \tag{1b}$$

Let the velocity $v$ be constant within layers. Say $v = v_i$ for the interval $T_i - T_{i-1}$. Then (1b) becomes

$$F_i = p[T_1 v_1^2 + (T_2 - T_1) v_2^2 + (T_3 - T_2) v_3^2 + \ldots + (T_i - T_{i-1}) v_i^2] \tag{2}$$

Using (2), form $F_{i+1} - F_i$

$$F_{i+1} - F_i = p(T_{i+1} - T_i) v_i^2 \tag{3}$$

Solving (3) for velocity and using (1a) to express $p$ in interval terms of measurements we get

$$v^2_{\text{interval}} = \frac{\partial t}{\partial f} \frac{T_{i+1} - T_i}{F_{i+1} - F_i} \tag{4}$$

The situation is depicted graphically in figure 1.

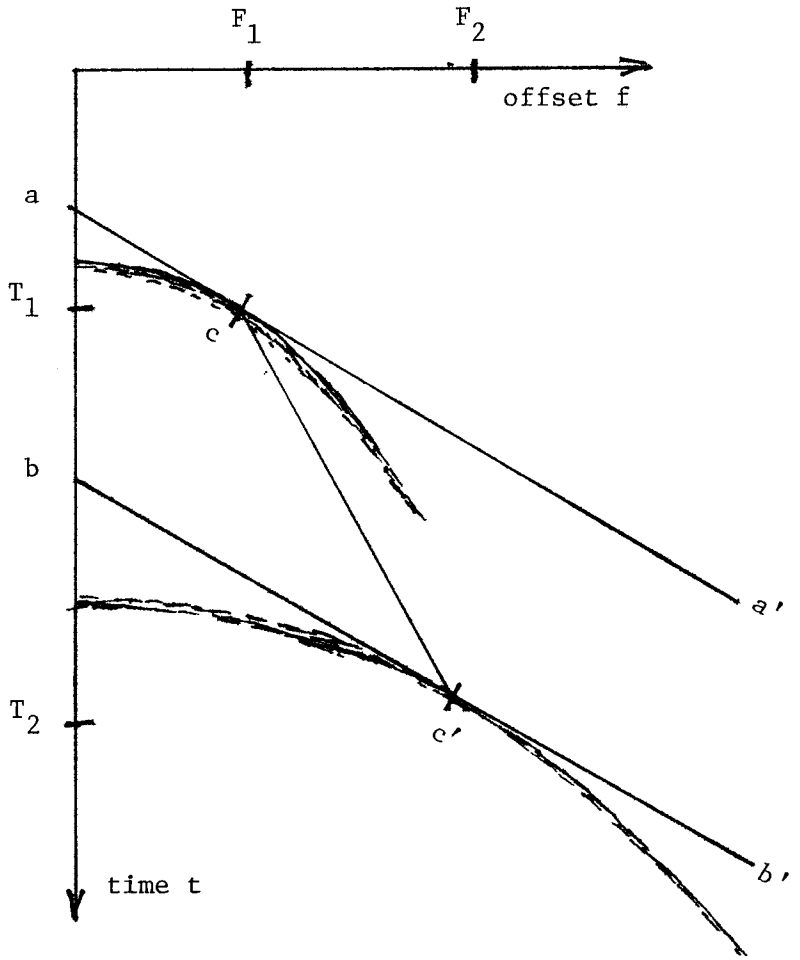


Figure 1 Construction lines on a common midpoint gather which has two hyperboloidal events. The interval velocity between the two events turns out to be the square root of the product of the slope of aa' times the slope of cc'.

Parallel lines aa' and bb' have been overlain on the common midpoint gather in such a way as to be tangent to the hyperboloidal events. The point of tangency of aa' to the first event has been picked at point c and has coordinates $(F_1,T_1)$ . Likewise the point of tangency of bb' to the second event has been picked at point c' and has coordinates $(F_2,T_2)$ . The derivative $\partial t/\partial f$ in equation (4) is the slope of the lines aa' or bb' . This slope is chosen arbitrarily at the interpreter's convenience. Naturally he will pick it so that the point of tangency to the data occurs where data quality is best. If a large amount of data needs to be analysed or if the accuracy of the interval velocity is particularly critical then it may be helpful to replot the data removing linear moveout. This provides the advantage that any horizontal timing line can be used in the role of aa' and bb' . Naturally equation (4) must be reinterpreted in view of the skewed coordinates, namely $T=T_{skewed}+pF$ .