10.1071/PVv2017n189p35

# Seismic window

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## Interpretation formulae

An old retired mate, I'll call him Dave, and I were chatting over dinner recently and both being seasoned interpretation geophysicists a question arose about how many complicated formulae we needed to know in our work. It turns out there is only one, which Dave and I both blurted out simultaneously.

$$D = VT/2$$

D = depth in metres

V = velocity in m/s

T = two way time in seconds

Of course there are other formulae like continuous wavelet transforms, migration algorithms, Shuey approximation, or even the Zoepritz equations, but we don't have to actually know them. Depth conversion, however, is our bread and butter and we use D = VT/2 daily. Naturally there are variations but they mostly take the form D = aVT/2 where for instance:

a = 0.001 for most interpretation software that specify travel time in milliseconds, or

a = –0.00l for a popular package that insists on using negative time, or

a ~ 0.9 to 0.95 for adjusting seismic derived depths to tie well tops.

It seems that Dave and I are trend-setters. At the recent EAGE meeting in Paris, Kurt Marfurt of Oklahoma University gave a presentation describing his idea of the future interpreter. The new age interpreter will not need to know much about wave propagation theory (or any formulae) but will need to know a lot about geology. The interpreter will be a mix of geologist, geophysicist and engineer with a broad knowledge of everything. Specialist tasks like rock physics and heavy mathematics will be handled by in-house experts or service companies. Table 1 is a compilation of things that an interpreter will need to know and those that not required according to Professor Marfurt. It would be interesting to know how many of today's interpreters have the required skills shown.

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Also at the EAGE meeting, several booths and presentations showcased software that is being developed to assist the interpreter. Future software will use machine learning algorithms and techniques developed in spyware and music recognition to ease the burden. This is not only a response to the approaching retirement of many skilled oil hunters but also to the growing amount of seismic data available. These days there are dozens if not hundreds of data volumes to review for a single survey, and it all needs analysing. Since humans have difficulty understanding the relationships between several types (more than four, say) of data and how it can be applied to well prediction this is inevitable. Hence, machine learning algorithms that iteratively learn from the data, self-organised mapping that classifies data, and spyware based software that will recognise keystrokes and repeat the steps to update a map with new data when, say, an extra well is drilled. Or music based software that could translate SEGY into a MIDI format and analyse attributes such as pitch or note length, searching for patterns to aid in stratigraphic interpretation. Self-organised mapping techniques could then be used to create a more robust interpretation.

These are exciting times and not a formula in sight!!

Table 1. The future seismic interpreter will have a broad knowledge of geology, geophysics and engineering without specialising in any one area according to Professor Marfurt

| NEXT GENERATION INTERPRETER | Skills required | Skills not required |
|---|---|---|
| Geology | Structural geology<br>Stratigraphy<br>Weathering/diagenesis<br>Well logs – tie to seismic, QC logs | Petrography<br>Petrophysics<br>• Other advanced skills |
| Geophysics | Post stack data conditioning<br>Seismic facies analysis<br>Recognise noise from signal<br>Impedance inversion<br>DHIs<br>Attributes to geocellular model<br>Integration with specialty data | Acquisition<br>Processing<br>Migration<br>Prestack data conditioning<br>Microseismic event analysis<br>Simultaneous inversion |
| Engineering | Pressure, mud weights etc.<br>Enhanced recovery<br>Microseismics related to completion<br>Dynamic modelling | Drilling<br>Completions<br>Bits<br>Mud selection<br>Corrosion |