Pressure pulse-code decomposition (PCD) @ model

Specific implementation of pressure spatial decomposition based on recognising the time pattern of flowrate variation pulse sequence in pressure response.

It constitutes the key interpretation procedure for PCT.

The decomposition algorithm is based on the minimisation of correlation functional X between generating well pressure variation $\delta p_G(t)$ and pressure trend $p_{R,\mathrm{tr}}(t)$ at receiving well after deducting the simulated pressure pulse-code response:

(1) $X[p_{uGG}] = \langle |p_{G,\mathrm{tr}}(t)|,\ |\delta p_G(t)| \rangle \to \min$
(2) $X[p_{uGR}] = \langle |p_{R,\mathrm{tr}}(t)|,\ |\delta p_R(t)| \rangle \to \min$

where

(3) $p_G(t) = p_{G,\mathrm{tr}}(t) - \delta p_G(t), \quad \delta p_G(t) = \int_0^t p_{uGG}(t-\tau)\, dq_G(\tau)$
(4) $p_R(t) = p_{R,\mathrm{tr}}(t) - \delta p_R(t), \quad \delta p_R(t) = \int_0^t p_{uGR}(t-\tau)\, dq_G(\tau)$

The generator's flowrate history $q_G(t)$, generator's wellbore pressure history $p_G(t)$ and receiver's wellbore pressure history $p_R(t)$ are assumed to be known for the whole period of the test.

The result of decomposition is the set of the unit-rate transient responses, DTRs $p_{uGG}(\tau)$ and CTRs $p_{uGR}(\tau)$), which characterise reservoir properties round generator and between generator and receiver.

The pressure trends at generator $p_{G,\mathrm{tr}}(t)$ and receiver $p_{R,\mathrm{tr}}(t)$ may have unknown origin but in order for decomposition t o work they should have minimum correlation with generating well flowrate variation $q_G(t)$. In terms of spectral analysis this means that pressure trend spectrum contains minimum overlap with spectrum of flowrate variation $q_G(t)$ a t generator.

This particularly means that pressure trends at generating and receiving wells may contain:

- low frequencies (created by monotonous activities of distant wells), which are lower than frequency range of the generating well flow variation $q_G(t)$

or

- high frequencies (created by lift instability at generating/receiving well), which are higher than frequency range of the generating well flow variation $q_G(t)$

If pressure trends contain components correlated with $q_G(t)$ (for example receiving well or distant wells have been synchronously varying the rates with generating well) then decomposition is not unique and should not be considered.

See Also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Well testing / Pressure Pulse Test / Pressure Pulse-Code Test (PCT)