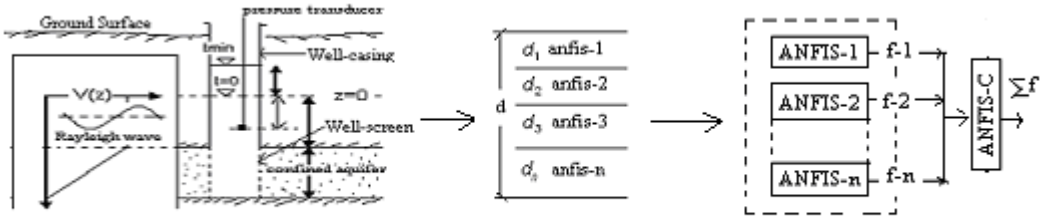
Sugeno-Fuzzy Modeling of Anomalies in Pressure Changes in Well-Aquifer System Excited by Rayleigh Waves

N P Dewangan, M F Qureshi
GCE, Raipur (CG) India
GP, Janjgir (CG) India
npdewangan@gmail.com, +91-771-2262396

The hydrodynamic process associated with the oscillatory water levels excited by the Rayleigh waves are influenced by the groundwater flow and its exchange into the well-aquifer system, momentum dynamics of the water column in the well casing and screen, various linear and non-linear losses, non-Darcian flow within the well-aquifer system etc. All these factors vary along the depth of the well-aquifer. As such, the momentum balance principle fails to deal with this depth dependent oscillatory response of well-water. Cooper has given the following sinusoidal function to test the anomaly:

$$\frac{H_e}{g}\frac{d^2h_w}{dt^2} + h_w + \beta\int_0^t \frac{dh_w}{d\tau}\frac{\exp(-\alpha/t-\tau)}{t-\tau}d\tau = h_0\sin(\omega t-\eta)$$



A Well-Aquifer System under Seismic Excitation Segmentation of Well Depth Conceptual ANFIS-Model

The conventional approach to the solution of Cooper Eq comprises many complicated non-linear equations. Focus is therefore made on segmenting the depth of well-aquifer, fuzzification of the parameters along this segment, formulation of IF-THEN rules and the MFs. For each segmental depth, a separate ANFIS is proposed to model its seismic response. The output of combined ANFIS is the aggregated response of the system on fuzzy plane.

Therefore, the present paper proposes a Sugeno-model based ANFIS for mapping the coseismic water pressure change at any depth of the well-aquifer system. The

advantages of ANFIS-modeling in approximating highly non-linear seismic phenomenon are also discussed with the result.

Keywords:

Well-aquifer system, momentum balance principle, Cooper eq., coseismic pressure change, Sugeno-Fuzzy model.

References

[01] Fuzzification of Aquifer System Parameters for Modeling its Seismic Response, MS'09-India [Presented]
[02] Response Simulation of a River Basin based on Sugeno-Fuzzy Model, MS'07-Terni, Italy[Presented]
[03] Rainfall-Runoff Modeling with ANFIS & Comparison with BPN & RBF Networks, MS'07-Algeirs [Presented]
[04] Fuzzy based Optimization and Analysis of Building Performance under Uncertainty, A-2007-AMSE [Published]
[05] Fuzzy Modeling of Seismic Wave Propagation in Semi-infinite Body referring Rayleigh waves and Development
of the Fuzzy Rule Base……Accepted for publication in AMSE
[06] Seismically induced Well Level Fluctuations in the Wali Well, Beijing China; Lan-Bo-Liu, Evelyn Roeloffs, X Y
Zheng, Journal of Geophysical Research, Volume 10, 1989.
[07] Chia-Shen Chen, Depth Dependent Pressure Fluctuation of Well Water due to due to Earthquake, NCU, Taiwan
[08] Ross, Timothy J, Fuzzy Logic with Engineering Applications, McGraw Hill International, 1997 Ed.