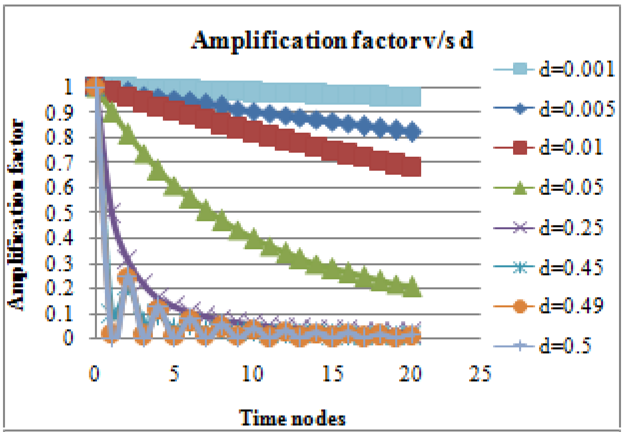

Figure 4: Error Amplification factor for d=0.005, 0.01, 0.05, 0.1, 0.49, 0.50

It is observed that for low value of "d" amplification factor is close to unity at the node at which error was introduced. So value of 'd' should not be too low or to say too much wider spatial grid will have error amplification close to unity during the initial wetting period .As the value of "d" increases the amplification factor also decreases sharply and oscillating magnifications are produced for d [0.45,0.5]. So the value of "d" need to be less than 0.5 .So decision to opt for a particular value of d depends on stability as well as processing speed of CPU.

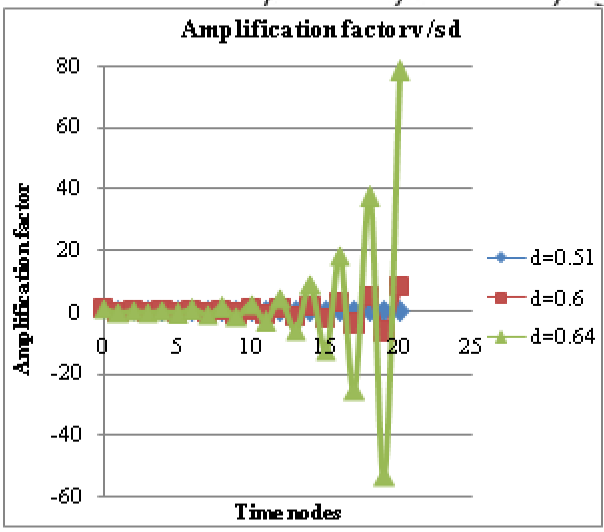

Figure 5: Error Amplification factor for d=0.51, 0.6, 0.64

It is observed that for high value of "d" amplification factor rises exponentially along with oscillations at node at which error was introduced. So "d" should not be too high or to say too much finer spatial grid may produce very high error amplification during the initial wetting period .As the value of "d" increases after 0.5 the amplification factor also increased sharply and oscillating magnifications are produced for d >0.5.So the value of "d" needs to less than 0.5 to keep error magnification below unity.

5. Conclusion

In simplified explicit θ-based solution of Richard's equation, ratio of $D_0 \, {}^{\Delta t}/_{[\Delta x]^2}$ affects the stability. At very low values, its error magnification is close to unity but less than 1 and at values greater than 0.5, it shows too much error magnification. So, for best results the above ratio needs to lie in the range of 0.25 to 0.5.

References

[1] Celia, Michael A., Efthimios T. Bouloutas, and Rebecca L. Zarba. "A general mass-conservative numerical solution for the unsaturated flow equation." *Water resources research* 26.7 (1990): 1483-1496.
[2] Hills, R. G., et al. "The Second Las Cruces Trench Experiment: Experimental Results and Two-Dimensional Flow Predictions." *Water resources research*27.10 (1991): 2707-2718.
[3] Hoffmann, Klaus A., and Steve T. Chiang. "{Computational fluid dynamics, Vol. 1}." *Wichita, KS: Engineering Education System* (2000).
[4] Hoffman, Klaus A., and Steve T. Chiang. "Computational Fluid Dynamics, Volume III. Wichita." *KS: Engineering Education System* (2000).
[5] Huang, K., B. P. Mohanty, and M. Th Van Genuchten. "A new convergence criterion for the modified Picard iteration method to solve the variably saturated flow equation." *Journal of Hydrology* 178.1 (1996): 69-91.
[6] Kampanis, Nikolaos A., VassiliosDougalis, and John A. Ekaterinaris, eds.*Effective computational methods for wave propagation*. CRC Press, 2008.
[7] Kumar, C. P. "Modelling of unsaturated flow." *National Conference on" Modern Trends in Water Resources Development and Environmental Management", Vellore Institute of Technology, Vellore (Tamil Nadu), str*. 2002.
[8] Pratap, Rudra. *Getting started with MATLAB: a quick introduction for scientists and engineers*. Oxford University Press, Inc., 2009.
[9].Shahraiyni, Hamid Taheri, and BehzadAtaie-Ashtiani. "Mathematical forms and numerical schemes for the solution of unsaturated flow equations." *Journal of Irrigation and Drainage Engineering* 138.1 (2011): 63-72.

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