

# Reply to Comment on “Bayesian Update and Method of Distributions: Application to Leak Detection in Transmission Mains” by Wang, Che, and Ghidaoui

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We thank the Comment’s authors both for their kind words about our analysis and for pointing out the need for further developments of our leak detection method. We agree with the authors that the performance of our method, like that of any data assimilation technique, is affected by, and must handle, ubiquitous measurement errors. That is why the generation of observational data in *Alawadhi and Tartakovsky* [2020] includes white noise  $\xi(t)$ , which “accounts for measurement errors and ambient noise. This gives a Gaussian observation model with mean  $h_{\text{obs}}(t)$  and variance 1.”

We also agree that the wave speed  $a$  is a potentially important source of uncertainty in field applications. It can be quantified by treating  $a$  as either a random variable or a random field. The method of distributions used by *Alawadhi et al.* [2018] to derive a deterministic equation for the PDF  $f_h(H; x, t)$  of pressure head  $h(x, t)$  can be modified to account for this eventuality. Two strategies for achieving that are derivation of i) a deterministic equation for the joint PDF  $f_{ha}(H, A; x, t)$  for the random variable  $a$  and the random field  $h(x, t)$ ; and ii) a PDF equation for  $f_h(H; x, t)$  that would require a closure, such as the Large Eddy Diffusivity approximation [*Venturi et al.*, 2013; *Wang et al.*, 2013]. We are currently pursuing this line of research.

## References

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