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*Major research interests:* **Multiscale problems,  
Numerical Analysis, Probability,  
Applications in solid and fluid mechanics**

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Multiple scale problems arise in many real world problems, typical examples are the flow of oil in a reservoir, and deformation of a composite materials. The problems depend on many spatial and time scales which differ very significantly from each other making them intractable by any analytical and conventional numerical methods. When the scales are separated, i.e. their ratios can be assumed to converge to zero in an asymptotic limit, the problems can be treated by the homogenization theory which deduces equivalent problems that approximate the originals in the limit. This limit problem only depends on the macro scale and can be treated by a conventional numerical approximation. I have studied diffusion in a perforated domain where there is a competition between the smallness of the diffusivity and the size and spacing of the holes. When the heterogeneity is distributed periodically, the problems can be treated by an analytic method but generally they need to be treated probabilistically.

The limiting problems describe the average of the solution in the large scale, but it does not provide the fine scale information on which the solutions to the original problems depend. Furthermore, an explicit numerical establishment of the homogenization equation can be expensive. In fact, there is a single equation that provides the solution of the homogenized equation and the fine scale information. Solving them we get all the desired information. However, this equation is posed in high dimension.

I have also worked on finding bounds for the effective quantities that represent the macroscopic properties of the solutions to the multi scale equations. It is not always possible to find these quantities exactly.

My other research interests are random partial differential equations modelling turbulence and applied complex analysis.

### Selected Publications

- V. H. Hoang, Random homogenization and singular perturbations in perforated domain. *Comm. Math. Phys.*, vol 214, 335-375, (2000).
- V. H. Hoang and K. Khanin, Random Burgers equation and Lagrangian systems in non-compact domains. *Nonlinearity*, vol 16, 819-842, (2003).
- V. H. Hoang and Ch. Schwab, High-dimensional finite elements for elliptic problems with multiple scales. *SIAM Multiscale Model. Simul.*, vol 3, 168-194 (2005).
- V. H. Hoang, High dimensional finite elements for periodic monotone nonlinear elliptic problems with multiple scales. *SIAM Multiscale Mod. Simul* (in the press).