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Environmental Engineering Seminar

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McDonnell Douglass Engineering Auditorium (MDEA)
1:30PM to 2:30PM

Simple Probabilistic Methods for the Design of Hydraulic Structures: Applications to Bridge Scour & Flood Protection



The scientific literature has widely shown that hydraulic studies are unavoidably affected by many sources of uncertainty and has proposed a plethora of probabilistic methods to account for them. Yet, in the engineering practice there is still a tendency to use traditional, deterministic approaches, also because most probabilistic approaches are too complex. This seminar discusses the need for simple probabilistic methods that can be widely used by engineers as a compromise between the current practice and sophisticated approaches. Reference to two typical hydraulic engineering problems is shown as an example: bridge scour and flood protection. The traditional prediction of bridge scour makes use of empirically derived equations and a single, representative value of the river discharge. This has led to under- or over-estimation of the bridge foundations and, as a result, bridge collapse or waste of economic resources. To address this issue, I propose a probabilistic approach based on coupling synthetic river flow simulation with scour modeling to determine the expected scour depth for a given lifetime of the bridge. The prediction of high water levels for the design of flood protection is traditionally based on the outcomes of a single hydraulic model and uncertainty is implicitly accounted for by adding a freeboard to the simulated flood profile. Here, I introduce a simple probabilistic approach that explicitly accounts for the most significant sources of uncertainty affecting hydraulic modelling. This application shows that deterministic approaches can under-estimate the design flood profile. Also, an issue with safe freeboards is that they are often arbitrarily defined (e.g. 1 foot or 1 meter) and misinterpreted as an additional safety level instead of a simplistic method to account for (in fact, unaccounted) uncertainty.

Dr. Brandimarte is interested in understanding the mutual interaction between fluvial processes and human activities. In particular, her main research interests are bridge pier scour estimation, flood risk management and hydropower vulnerability assessment.

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