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10 Questions to Prof. Heidi Nepf

Hydrolink

10 QUESTIONS TO... Prof. Heidi Nepf

Interviewed by Michele Mossa

What do you think about the development of the research in Hydraulics in the next future?

Because of the increasing stress placed on water resources throughout the world, I see a resurgence and reinvention of hydraulic engineering, as communities try to improve the efficiency and capacity of water storage and delivery systems. At the same time, hydraulic research at the intersection with ecology and environmental processes will expand, as researchers respond to the need to manage and protect natural resources.

> *"There is a particular need to expand the database of field observations"*

Your main research activities examines physical mechanics which affect the transport and fate of contaminants and nutrients in surface water systems with key projects focusing on wetland and vegetated hydrodynamics. What is your opinion on the level of this research now in the world and which parts of it should be studied much more in deep?

The interplay between flow and natural roughness is a fascinating and complex problem that sets the habitat conditions for many species, e.g. mussels, aquatic grasses, kelps, terrestrial forests, corals. This area of research has grown rapidly in the last few years, and I think it will continue to expand, because it is at the core of so many ecosystem services, such as water clarity and water quality enhancement, habitat provision, and coastal protection, and also influences the engineering designs for flood routing, irrigation, and storm surge prediction. While there is much work to be done at many scales of these problems, there is a particular need to expand the database of field observations, including measurements of flow, transport and resistance, as well as surveys to characterize the range of natural geometric configurations [patch sizes, organism density].

Which are the main goals that your research team has reached in the last years?

My team explores how the presence of vegetation in channels and coastal zones alters the mean and turbulent velocity field associated with unidirectional currents and waves. Further, we examine how vegetation impacts the fate and transport of sediment, as well as the possible feedbacks between vegetation and bed morphology. At the scale of individual blades, we are studying the interplay between fluid motion and blade motion for different ratios of blade rigidity, blade buoyancy and hydrodynamic drag.

Which kind of interactions and cooperation with other research branches could be worthwhile on this topic?

There are obvious connections to ecology and plant physiology, as well as to sediment transport, geomorphology, and erosion science. Vegetation hydrodynamics also plays an important role in the engineering areas of treatment wetland design, channel and coastal restoration, and flood management.

Your research topics involve also physical hydraulic laboratories. Regarding the theme of pollutant transport, which future do you expect on these laboratories?

Proper hydraulic modeling usually requires a large physical laboratory. Unfortunately, many institutions have reduced the size of, or eliminated such laboratories to make space for other endeavors. I hope this trend can be reversed in the future, because properly scaled laboratory studies provide vital insight into physical processes, critical validation data for numerical modeling, and an essential bridge between idealized small-scale studies and field-scale application. I encourage institutions to continue their investment in facilities for large-scale physical modeling.

Dr. Heidi Nepf is a Professor of Civil and Environmental Engineering at the Massachusetts Institute of Technology. She received an MS and PhD in Civil Engineering from Stanford University (1992) and then spent one year as a Postdoctoral Fellow at the Woods Hole Oceanographic Institution, before coming to MIT in 1993. Her research team has produced over 60 refereed journal and conference articles in the field of environmental fluid mechanics. She recently served on the US National Research Council's Review of the Louisiana Coastal Protection Restoration (LACPR) Program. Active in educational outreach, Dr. Nepf has served as a technical advisor to several PBS, NSF, and ASCE sponsored programs. She is a member of the IAHR Fluid Mechanics Committee.

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In order to reduce pollution generated by oil spills during the last 2 decades many countries sustained a strong scientific and technological effort for developing adequate pollution contingency. Anyhow some disasters still happen. In your opinion which role the research community has to have on this point?

It is the responsibility of the research community to ensure that their work is communicated to engineering practice and governing bodies as quickly as possible, and the tools for such engagement should be a part of an engineering education. In addition, the research community should be encouraged to respond quickly to disasters, both to support the rescue and recovery efforts as well as to gain valuable scientific understand of such events. Governments and foundations should facilitate access to funding that supports the rapid engagement of the scientific community after specific events.

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Do you think that political authorities and administrations do not have sufficient sensibility on this theme and, generally speaking, on environmental themes?

Political authorities have become quite sensitive to environmental themes, but lack the financial resources and/or political consensus to make positive progress on many environmental issues. The situation is also hindered because the engineering activities associated with environmental protection and management typically lack the private sector financial backing seen in other fields of engineering, e.g. biotechnology, computing, energy, transportation.

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Someone thinks that our development should be limited in the next future and that the period during which the development was without any limit is finished. What is your opinion on this point?

I agree that development should only proceed within the constraint of sustainability. Further, future development should put more focus on the elimination of the global inequities in the access to basic necessities [clean water, safe shelter, food] as well as modern necessities [telecommunication, clean power]. It is necessary to meet these needs as well in a sustainable way.

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Contaminated water and poor sanitation is still a major cause of illness, with diarrheal disease being the principal cause of morbidity and mortality in children under 5 years in developing nations. […] Engineering solutions drove the reduction of water-related illness in the nineteenth century emergent conurbations of the industrialized nations of today. In your opinion how can the hydraulic community help to solve this worldwide problem?

Contaminated water supply and poor sanitation remain a major problem in developing regions. In many cases one cannot simply relocate conventional technology to these regions. More creative solutions are needed that apply the principles of appropriate technology, i.e. technology designed with specific consideration of the economic, cultural, and resource conditions of the community to be served. In many cases, the solution will be local, i.e. at the house to village scale, as opposed to the regional scale solutions currently in place for major metropolitan areas in developed regions.

"I see a declining interest in science and engineering among American youth"

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As usual, the last question is not exactly a question. You are free to direct to our readers to send them a message of yours on a topic that is dear to your heart.

I encourage state and local governments as well as individuals to invest in our youth. I see a declining interest in science and engineering among American youth, yet these disciplines are essential for solving our environmental and resource problems. Further, a basic scientific literacy should be provided to all youth, so they are prepared to make the critical societal choices they will face in the future.