Majid Hassanizadeh From Iran: a Traveler Between Cultures and Disciplines

His career path took him from Iran to the USA and the Netherlands: Majid Hassanizadeh, Hydrogeology Professor of the University of Utrecht, has developed basic methods that can be used by experts to describe the flow behavior of fluids, gases and particles in porous materials like the soil. This has brought him numerous honors, including an Honorary Doctor's title from the University of Stuttgart. Currently he is at work at NUPUS, a graduate college for international training in this field.

Pulling a compact trolley suitcase behind him, Majid Hassanizadeh comes in jeans and a striped blue shirt into the building where the Chair of Learning for Hydromechanics and Hydrosystems Modelling is located. He's well known here, and the colleagues greet him cordially. Hassanizadeh's interests as a hydrogeologist bring him here as much as five times a year to visit Professor Rainer Helmig. In fact, Hassanizadeh already spent 6 months here back in 2010 as a Humboldt research prize winner.

This time he's here for a NUPUS Graduate College Conference on „Non-Linearities and Upscaling in Porous Media" cooperatively sponsored by the University of Stuttgart together with the Dutch universities of Delft, Eindhoven, Utrecht and Wageningen and the Norwegian University of Bergen. Together with Helmig, Hassanizadeh founded the College in 2006 and acts as spokesman for the Dutch participants. Master's Degree students and doctoral candidates have access to advisory services from all participants, along with courses and workshops for budding researchers and a lively exchange of ideas among all participants. „NUPUS brings together different approaches to tackling the many applications of porous media," says Hassanizadeh, who originally graduated in Civil Engineering.

The practical applications couldn't be more diverse: Hassanizadeh's first research interests involved the path taken by groundwater through infinitesimal cracks and pores in the soil and whether it becomes impure when atomic wastes are stored in surrounding layers of rock. Actually, water has always fascinated him: „In Iran, my home country, water is rare and precious, and to us, the sound of running water is one of the most beautiful sounds in existence," says Hassanizadeh. After a while, it hit him that researchers in other disciplines apply the same theories and modelling methods as in groundwater science: all of them deal with fluids, gases and particles and their dissipation into porous materials – an indispensable knowledge for pumping oil out of shale layers buried deep underground, for example.

From Groundwater Research to Diapers and Ink-Jet Printers

While in Holland, his new home, Hassanizadeh, who is now 63 years old, began expanding his field of research. His studies took him next to flow behavior in fuel cells and how to optimize the way they generate energy; then he analyzed the way in which chemotherapeutical agents spread throughout the brain. And now, among other things, he is studying improvements in the way diapers absorb fluids and paper absorbs ink from ink-jet printers. Also, the teams of Hassanizadeh, Helmig, and Bernhard Weigand of the University of Stuttgart's Institute of Aerospace Thermodynamics (ITLR) are analyzing interface applications between air and porous structures in a new cooperative project with the University. They want to find out, for example, whether a thin porous coating can prevent airplane wings from freezing over in winter. „Majid Hassanizadeh has a knack for analyzing questions with different origins in such a way that the parallels between them become clear. That's a gift few people have," says Rainer Helmig. Taking their inspiration from the NUPUS Graduate

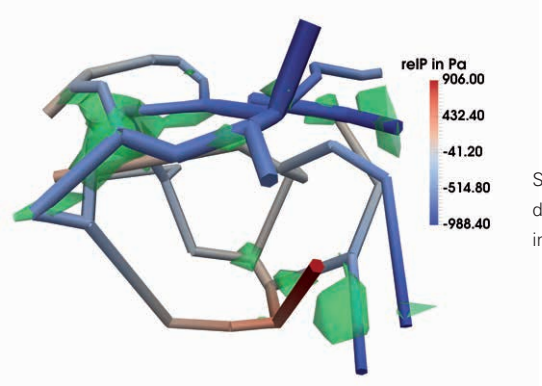
College, the two, who had been science partners for many years, decided to bring all branches of research in the field under one roof, found interested partners, and in the end founded the International Society for Porous Media (InterPore). Hassanizadeh reminisces: „We started, for example, with hydrogeologists, petroleum engineers and materials engineers doing research on the related topics. They held their own conferences, published results in their own scientific journals, and had little contact with each other."

Photo: Helmine Braitmaier

Zooming Into An Infinitesimal Pore

Today, his theoretical work on the derivation of conservation equations for flow and transportation in porous media are the basis for most of the computer simulations with which scientists and engineers simulate the actual underground behavior of water, oil, and air, for example, in virtual reality. The calculations are usually performed by averaging out events governed by physical laws in a single pore over thousands of pores in order to predict how fluids and gases spread throughout the porous soil material.

One starting point for his research was the famous Darcy Law in groundwater science, first formulated in 1865 by the French engineer Henry Darcy to describe permeation in porous media. „However, it fails to take into account that different fluids interact not only with the porous material but also with one another," explains Hassanizadeh. As a hydrologist, he therefore introduced a new variable into the physical equation to account for this interaction and increase the accuracy of calculations by simulation. Hassanizadeh is especially proud of the research laboratory which he was able to establish three years ago in Utrecht with the support of hefty funding from the European Research Council which thus honored him as an established front-rank researcher. „With the microscope there we can zoom into microscopic pores and use cameras to make real-time films of fluids and gases as they permeate into the channels of a porous material and what happens when we change the conditions," says Hassanizadeh. The experiments are indispensable for further improving existing computer models. That is an interface where the teams of Hassanizadeh and Helmig supplement each other: „We supply the expertise in basic theoretical guidelines and experimental studies, and Helmig's team is renowned for its simulations and modelling tools," says Hassanizadeh.



Simulated dispersion of medicinal drugs out of a capillary network into the surrounding tissue.

„Germany is Generous With Research"

Hassanizadeh has come a long way in his career, which spans more than 40 years. He has been a traveler not only between research disciplines but among cultures as well. Once he had his Engineering Bachelor's degree in the bag, he was drawn as a young man from Iran to Princeton University in the USA, where he began his trailblazing theoretical studies on fluid movement in porous media. Four years later he returned with a Doctor's Degree. But, disappointed by the Iranian revolution, during which the universities were closed, he turned his back shortly thereafter on his homeland. „How is it possible to have a successful academic career here?" was Hassanizadeh's question.

After a year off in the Netherlands for advanced studies, he again got a whiff of research atmosphere in the year thereafter, and: he stayed. „All those years it had always been our plan to return to the homeland," confesses the renowned scientist. „But it's not easy today to carry out top-notch research in Iran: research is not a top priority of the government, and both funding and the necessary infrastructure are lacking," says Hassanizadeh, and praises Germany: „Compared with other countries, including the Netherlands, Germany provides far more funding for research." Then too, there is much competition among the universities in Germany.

At year's end, the NUPUS Graduate College will reach the end of its term, but the close cooperation between the teams of Helmig and Hassanizadeh will continue. That is ensured by a new international research network which will intensify research cooperation and the training of Doctoral students in the field of porous media. Among the participants are not only the present NUPUS partners but also other work groups from the USA, Scotland and Switzerland. The University of Stuttgart will help finance the cooperation in research during the next three years to the tune of 160,000 Euros in all.

Helmine Braitmaier