This Special Issue presents a set of papers presented to the special session "Design generation and evolution of flow systems" of the 7-th International Conference on Diffusion in Solids and Liquids – DSL2011[†]

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Natural and engineered flow systems have an intrinsic beauty visible for everybody. They are not amorphous – they have configurations (designs). Concepts and principles of fluid dynamics and heat transfer are fundamental to describe these systems. The ability to understand and predict things is related intimately to the scientific process.

From the very early days where some basic ideas in fluid motion were introduced (complex flows over objects in streams were observed and sketches drawn by Leonardo da Vinci (1452 – 1519)), to the essential contribution of Newton's Book II of *Principia Mathematica* (1687), where a mathematical formulation of fluid flow started to take shape, and to the present it has been a long and fruitful journey. Efforts to improve the theoretical understanding (analytic theory) and experimentation are still taking shape. Numerical simulation (computation) provides a definitive tool that can be used to provide high-fidelity computer-based observations of the phenomena. All these efforts are generating many opportunities to develop new avenues of research.

In this Special Issue we choose a set of manuscripts that illustrates breadth of applications that can occur. They are experimental and computational studies, underpinned by theoretical understanding, in the quest for bringing new insights and developments to scientific questions.

The film flows of liquids are important for several technological processes. The first paper in this Special Issue, authored by Aleksandr Pavlenko, addresses the structure and dynamic of a self-maintained evaporation front. In the second paper, Nikolay Pecherkin and co-authors study the hydrodynamics and heat transfer of the falling films of binary mixtures on the surfaces with complex geometry.

Fluid flow through porous media is important in many problems of scientific, environmental and industrial interest, including extraction of oil, waste disposal, filtering operations, etc. The third paper in this Special Issue, by Davide Allori et al., covers the flow through maco-porous model structures to study basic effects of pores on the fluid flow and to derive a similitude criterion based on physical insight of the considered problem. The work of Pedro Almeida and co-workers covers the flows through organic porous media based on a non-Darcy flow equation and compares the analytical results with experimental data (paper 4).

Over the past several decades, computation has joined analytic theory and experimentation as a powerful tool in the advancement of science. Martin Fuchs and co-authors studied the effect of mesh characteristics on turbulent cavitating flows described by the Menter shear stress transport (SST)

[†]Selected materials are marked as "DSL2011 invited paper"

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model (paper 5). The last paper of this issue, by Christian Maier et al., studied both numerically and experimentally the aero-acoustic noise created by turbulent flow over a circular cylinder.

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