CMF-Controlling Multiphase Flow

This project aims to unravel the physical mechanisms and underlying interactions of the rheological properties of complex emulsions also under flowing conditions.

Local vs Global Rheology (Akankshya Majhi, WUR)
Measuring and understanding the spatiotemporal microstructure of complex fluids in flow is important in complex fluids. To resolve the link between the microstructure and macroscopic flow behaviour of complex fluids, we will combine bulk rheological measurements to interparticle force measurements (using microfluidics) and boundary stress measurements (using photoelasticity). We have already used 3D printing to design and test flow geometries (see figure) that demonstrate how intelligent design of wall effects in flow geometries can optimize bulk flow behavior.

Emulsion Stability at Extreme Conditions (Bijoy Bera, WUR)
Oil-in-water emulsions are often subjected to extreme conditions such as high shear or enhanced gravity. The understanding of the fundamental behavior of such emulsions in extreme conditions, however, remains limited. We have built a novel microfluidic setup where the emulsion can be subjected (simultaneously) to higher gravity (using centrifugal force) and higher temperatures. We study and model the droplet dynamics, coalescence and interpret the influence of thermal fluctuations in the thin water film upon the coalescence and compression patterns.

Laser Speckle Imaging (Jesse Buijs, WUR)
Laser speckle imaging (LSI) is a powerful imaging technique that visualizes microscopic motion within turbid materials. At current there are two methods are widely used to analyze speckle data: one is fast but qualitative, the other quantitative but computationally expensive. We have developed a new processing algorithm, that converts raw speckle patterns into maps of microscopic motion, which is based on the fast Fourier transform (FT). The FT-LSI method is quantitative and orders of magnitude faster than existing quantitative methods.

Pickering Emulsion Stability & Rheology (Riande Dekker, UvA/UU)
The preparation of an emulsion requires the formation of interfacial area, often induced by applying a high shear and thus much energy. We create interfacial area by temperature-induced phase separation of a binary mixture. To prevent full phase separation, we add colloidal particles to the binary mixture, thereby forming solid-stabilized emulsion droplets. We study the influence of additional components that preferentially dissolve in droplets.