Challenge on sensor technology for a nature solid-liquid flow—surviving heterogeneous and severe flow condition

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Accurate and timely measurement of shear stress in an unsteady fluid flow has long been a challenging task in conventional fluid mechanics. One major challenge resides in sensor calibration in unsteady flow condition. The existing sensing techniques can hardly be applied in a collision-rich solid-plus-liquid flow due to the impulsive nature of inter-particle collision. The stress resulted from normal particle impact or tangential surface sliding can differ by several orders of magnitude from that caused by pure fluid shearing at the solid boundary. The corresponding time intervals for particle collisions and liquid shearing also require sensors of distinctive response times.

What further complicates the measurements is that particle collisions away from the sensor often create hydrodynamic impulses that are transmitted to the sensor through the liquid medium. Such signals may be characteristically different from the two previously described and they are generated so frequently that may cause sensor overload. Lastly, water-proof and damage-protection from direct collisions might be other critical aspects for successful sensing technology for a ‘noisy’ and severe flow condition which likely to occur in many hazardous solid-liquid flows.