Articles eligible for the Monaghan Prize

Xu, R., Stansby, P., Laurence, D. (2009) Accuracy and stability in incompressible SPH (ISPH) based on the projection method and a new approach, Journal of Computational Physics 228:6703-6725
doi:10.1016/j.jcp.2009.05.032
This paper first introduced 'shifting' within the context of SPH. It demonstrates the enhanced stability and accuracy achievable for a wide range of Reynolds numbers, at little computational expense. The effectiveness, universality, and ease of implementation of shifting make it one of the key SPH developments in recent years."
Grand Challenge(s) addressed: Numerical Stability

Dehnen, W., Aly, H. (2012) Improving convergence in smoothed particle hydrodynamics simulations without pairing instability, Monthly Notices of the Royal Astronomical Society 425:1068-1082
doi:10.1111/j.1365-2966.2012.21439.x
open-access version
The authors show that the Fourier transform of the kernel is the key tool in analyzing the stability behavior of SPH. The Wendland kernel is thus proved to perform better than the B-splines. The authors point out the importance of using the kernel standard deviation in place of the smoothing length. This paper offers new insights in the study of the SPH numerical properties.
Grand Challenge(s) addressed: Numerical Stability

Colagrossi, A., Antuono, M., Le Touzé, D. (2009) Theoretical considerations on the free-surface role in the smoothed-particle-hydrodynamics model, Physical Review E 79:056701
doi:10.1103/PhysRevE.79.056701
open-access version
Generally, free-surface boundary conditions are said to be "intrinsically" satisfied in SPH, but previously, there were no rigorous justifications for this statement. This article explains why the anti-symmetrized divergence is consistent when approaching the free surface, and unveils very important issues of pairs of divergence and gradient formulations regarding their consistency, conservation properties in modelling free surface boundary conditions.
Grand Challenge(s) addressed: Convergence, Boundary Conditions

Marrone, S., Colagrossi, A., Le Touzé, D., Graziani, G. (2010) Fast free-surface detection and level-set function definition in SPH solvers, Journal of Computational Physics 229:3652-3663 doi:10.1016/j.jcp.2010.01.019
open-access version
The authors' algorithm proved to be effective in free surface detection and very fast. Results show a good balance between innovation, effectiveness and simplicity of implementation. The proposed algorithm may have very important applications in several fields of interest for the SPH community.
Grand Challenge(s) addressed: Boundary Conditions

Marongiu, J.-C., Leboeuf, F., Caro, J., Parkinson, E (2010) Free surface flows simulations in Pelton turbines using an hybrid SPH-ALE method, Journal of Hydraulic Research 48(Supp 1):40-49
doi:10.1080/00221686.2010.9641244
open-access version
This is one of the first papers dealing with SPH-ALE with a Riemann solver formulation. The authors treat application to water impact and validate on a complex 3D test case. The method is able to treat this geometry in a more rigorous way than the "repellent-particles" technique and in an easier way than the "ghost-particles" technique.
Grand Challenge(s) addressed: Numerical Stability, Boundary Conditions

Fatehi, R., Manzari, M.T. (2011) Error estimation in smoothed particle hydrodynamics and a new scheme for second derivatives, Computers & Mathematics with Applications 61:482-498
doi:10.1016/j.camwa.2010.11.028
open-access version
The article addresses the issue of first-order consistency of second-order discrete operators in SPH. The proposed method shows a better accuracy and a better convergence order than any of the existing SPH second-order operators. For all processes involving a second-order operator, like viscous forces, thermal conduction, density diffusion and pressure Poisson equation, this is a significant advance.
Grand Challenge(s) addressed: Convergence