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A stabilised mixed meshfree method for incompressible media: Application to linear elasticity and stokes flow

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Highlights (for review)

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- A stabilised, mixed, meshfree method, using equal order interpolation scheme for both displacement and pressure variables, is proposed to enforce the incompressibility constraint.
- In order to stablise the unstable, equal order mixed formulation, the polynomial pressure projection (PPP) stabilisation scheme is employed.
- However, the stabilisation could fail due to integration error of rational meshfree basis functions, restricting the application of the method in meshfree methods. This is addressed using a gradient correction scheme, leading to a modified weak form, which is different from, and more robust than the original stabilised mixed weak form of PPP.
- In order to accommodate a quadrilateral background mesh, the gradient correction originally proposed by Duan et al (2014) is further modified.
- The new stabilised, mixed, meshfree method passed the linear and quadratic mixed patch tests, and converged optimally when tested on a Timoshenko beam problem and a Stoke's flow problem.
- A solution for the incompressible Timoshenko beam under plane stress is derived, since the published classical plane stress solution is not incompressible.