CORRECTED SMOOTH PARTICLE HYDRODYNAMICS —
A reproducing kernel meshless method for computational mechanics

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1 INTRODUCTION

Recently, a number of meshless techniques have been developed which do not require solution points or particles to be connected together by a conventional finite element mesh. Instead, the necessary computations at a given point are based on function values at neighbouring points. Smooth particle Hydrodynamics (SPH) was the first of such methods and has been successfully used for a variety of physical problems [1,2]. More accurate techniques, such as Element Free Galerkin Methods (EFG), Moving Least Square Approximations and Reproducing Kernel Particle Methods have been recently developed by several authors [3-5].

This paper presents a Corrected Smooth Particle Hydrodynamics Technique which can achieve similar order of accuracy than moder methods whilst retaining the simplicity of the original SPH technique and thus being suitable for explicit computations.

2 REPRODUCING KERNEL APPROXIMATION

The basis for SPH and similar methods is a reproducing kernel approximation of an arbitrary function $f(\boldsymbol{x})$ in terms of a kernel function $W(\boldsymbol{x}, h)$ to give (see figure 1).

$$\langle f(\boldsymbol{x})\rangle = \int_D f(\boldsymbol{x}')W(\boldsymbol{x}-\boldsymbol{x}', h)\, d\boldsymbol{x}' \tag{1}$$

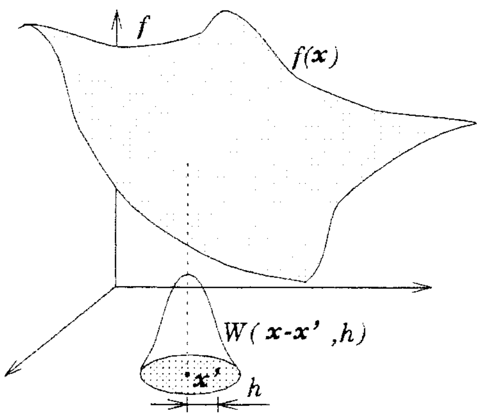

Figure 1 Reproducing Kernel Approximation

Clearly, the reproduced function $\langle f(\boldsymbol{x})\rangle$ will converge to the exact function as $W(\boldsymbol{x}, h)$ approaches the Dirac delta function $\delta(x)$. Furthermore, by careful selection of this kernel function, it is possible to ensure that polynomials up a given degree k are exactly reproduced by the above integral. To show this consider a simple 1-dimensional