# The potential of director theory to the application of cardiovascular modelling

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The aim of this project is to investigate whether a director theory approach to modelling fluid flow in pipes could prove useful to the modelling of blood flow in the human cardiovascular system and ultimately be used as a diagnostic tool. The motive is to find a acceptable balance between accuracy and computational efficiency. The director theory approach allows for curvature of pipes and hence can provide a more realistic model of the complicated geometries of blood vessels than can classical 1D models. Yet it is simpler and hence compuationally cheaper than full 3D simulations. The idea of director theory is that the velocity of the fluid flow can be approximated by a series of director velocities which depend on the direction along the centreline of the pipe and time, multiplied by shape functions which depend on the cross-sectional coordinates. The shape functions are often chosen to be polynomials and their exact form is detemined by boundary and other conditions such as continuity. Then the director velocities are solved for by taking integregated versions of the Navier-Stokes equations over the cross-section. So far we have applied this theory to modelling fluid flow in straight and toroidally curved pipes. In straight pipes, we were able to recover the Poiseuille solution as well as a decaying swirling solution. In the toroidally curved case, the flow field matches well with a simulation ran in STAR-CCM+.