Optimal design of gas burst gene gun.

Description:

A gene gun consists of a tube that is configured to propel DNA-coated micro-particles, currently tungsten or gold, into a wide range of biological samples. There are a number of propulsion methods that have been investigated in the past including but not limited to electric discharge, gun powder explosions, bursts of helium gas and gas flow.

One particular helium burst system (Bio Rad PDS 1000/He) propels a kapton disk coated with the micro-particles into a stopping screen. The momentum of the disk is transferred to the micro-particles which continue into the cellular structure of the target. The first challenge is to model the flow of the gas-particle suspension. If the pressure is too high, the biological sample can be damaged. Is there an optimal pressure that maximizes the acceleration of the micro-particles? Is there any advantage in shaping the pressure pulse?

The kapton disk is not mechanically guided into the stopping screen. As a result, the actual centre of impact of the micro-particles can change from one run to the next. The second challenge is to consider the addition of a nozzle which both focusses the flow of the micro-particles as well as allowing one to change velocity distribution of the exiting micro-particles. For a given nozzle exit velocity distribution, can a corresponding nozzle geometry be found?

The third and final challenge is to model the behaviour of the target. In particular, to reproduce the observed penetration depth distribution for a given nozzle exit velocity. This is complicated by the fact that the biological sample is a highly anisotropic layered medium.