FLOW AROUND BUILDINGS USING LATTICE BOLTZMANN METHOD (LBM) ON GRAPHICS PROCESSING UNIT (GPU)

This work involves the simulation of flow over buildings using the LBM. The Lattice Boltzmann Method is a powerful technique for the computational modeling of a wide variety of complex fluid flow problems involving single and multiphase flow over complex geometries. The current work was of interest to our customers in Defence laboratories, who need a tool to dynamically simulate the flow over standing structures in a city with or without particulate suspensions.

The LBM is a discrete computational technique which requires the simulation domain to be split into equally spaced lattice nodes. Flow state at each lattice point is defined by a distribution function, which is the probability of a lattice site to have a particle heading at a particular direction at a given time. The macroscopic variables such as the velocity, pressure etc. is obtained as a function of the distribution function at each time step. The fluid particles collide and propagate at each time step. The major advantage of the method is that it can be readily parallelized and it can handle very complex geometries where traditional computational techniques may fail.
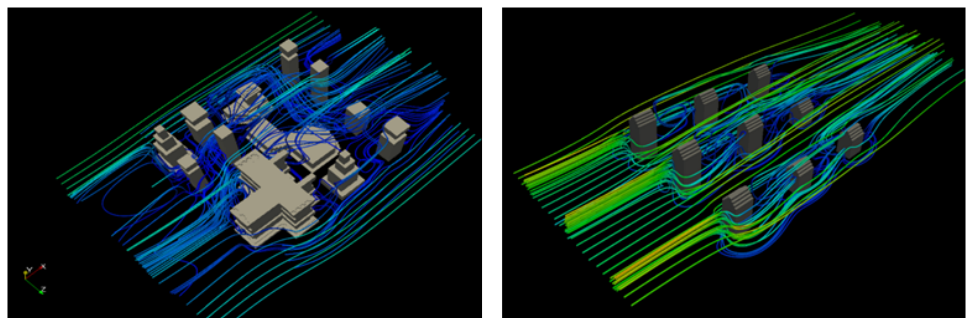

Figure 78: (a) Flow over a model city block 1 (b) Flow over model city block 2

Simulation was done on different set of buildings in a city block shown in Figure. The use of GPUs is extremely beneficial as it is very efficient and has faster computational time and has a parallel execution model.