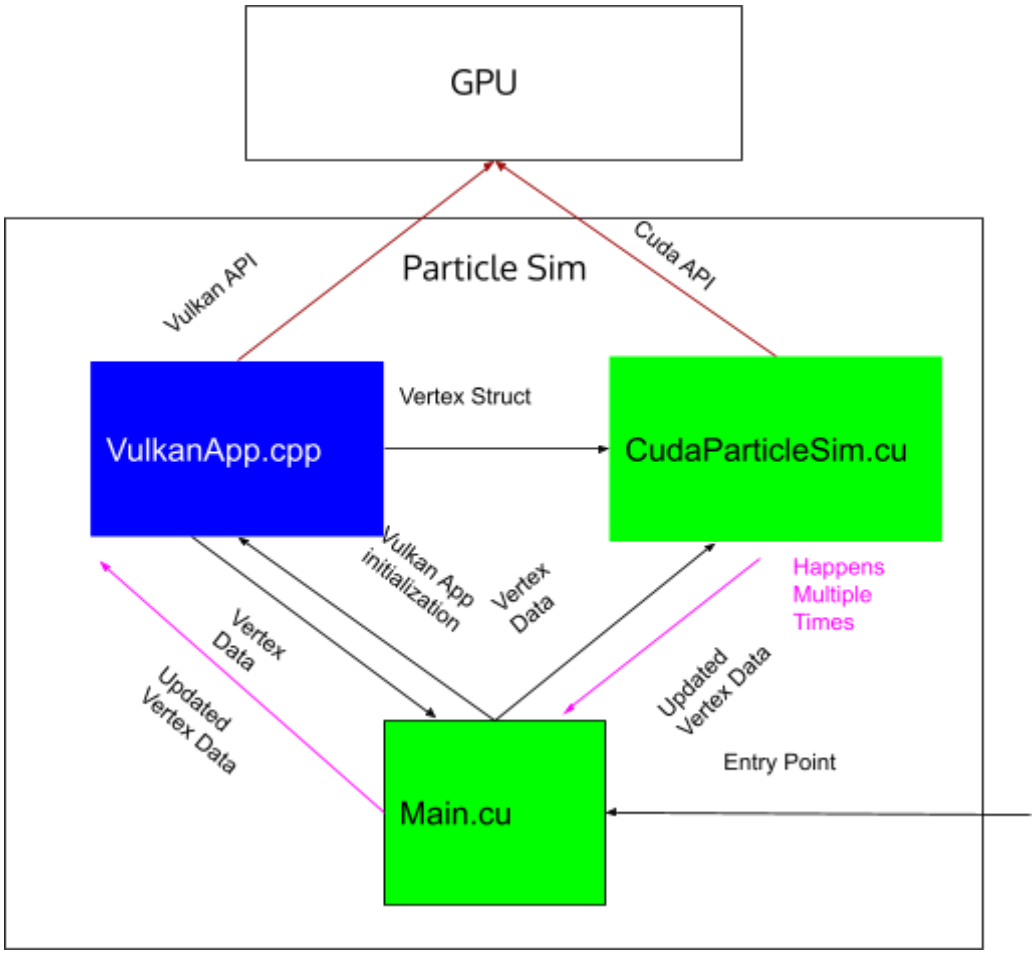
Cuda Particle Sim

Requirements

- Cmake 3.21
- Vulkan SDK 1.2 or Higher
- CUDA (NVCC with c++ 17 or higher)
- GLM
- GLFW

High Level Outline



Main.Cu Physics Engine

Force/Position/Velocity Calculations

$$F_g = G\frac{m_1 m_2}{r^2}$$

$$\vec{F_g} = G\frac{m_1 m_2}{r^2} \cdot \frac{[\Delta x, \vec{\Delta} y, \Delta z]}{r}$$

$$r_t = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$$

Net force is calculated using the following Algorythm b being the total number of particles

$$\vec{F_{net,n}}(t) = \sum_{a=1}^{b} \begin{cases} a \neq n & G\frac{m_n m_a}{r_t^2} \cdot \frac{[\Delta x, \vec{\Delta} y, \Delta z]}{r_t} \\ a = n & 0N \end{cases}$$

New position and velocity are calculated with velocity verlet

$$\vec{a_n}(t) = \frac{\vec{F_{net,n}}(t)}{m}$$

$$\vec{x_n}(t + \Delta t) = \vec{x_n}(t) + \vec{v_n}(t)\Delta t + \frac{\vec{a_n}\Delta t^2}{2}$$

$$\vec{v_n}(t + \Delta t) = \vec{v_n}(t) + \frac{\vec{a_n}(t) + \vec{a_n}(t + \Delta t)}{2}\Delta t$$

These calculations are done in parallel by CudaParticleSim.cu