



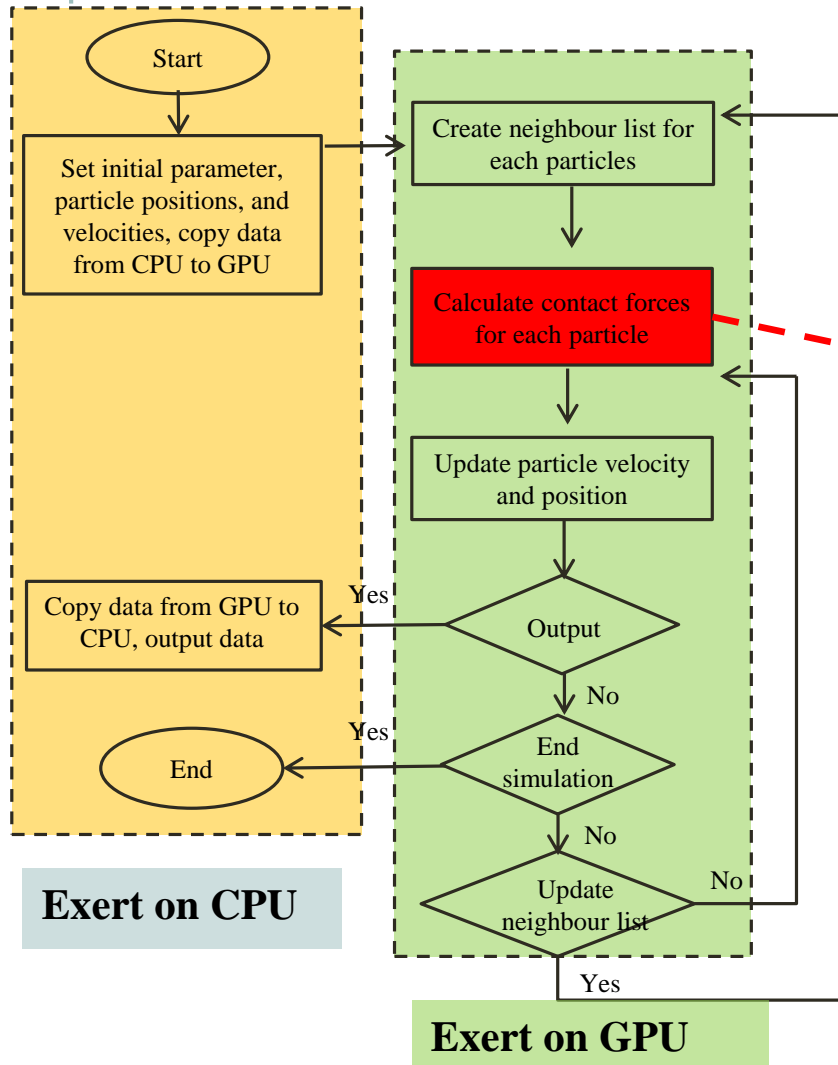
# GPU-DEM Application in bulk materials handling and processing

## Dr. Jieqing Gan

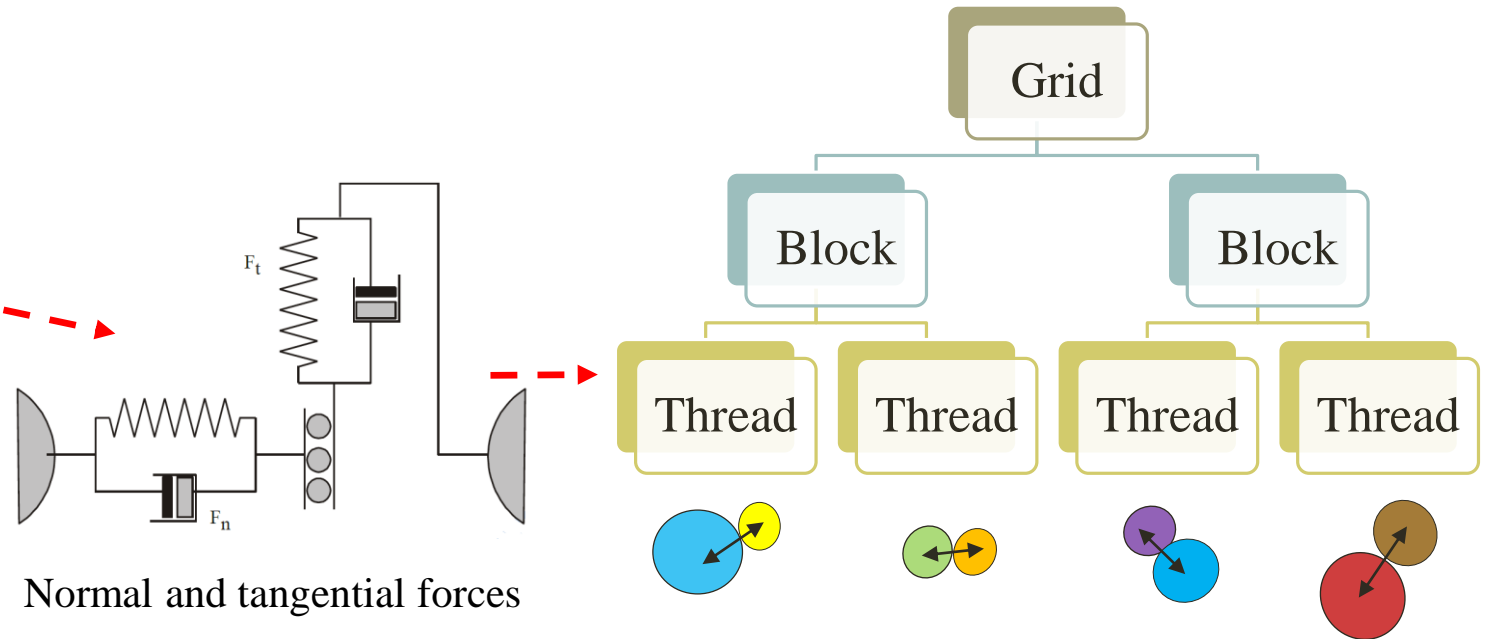
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# GPU-DEM

## GPU-DEM flow chart



## Graphic Processing Unit (GPU) thread hierarchy:



Normal and tangential forces

### Monash Massive3 V100 GPU cluster:

Max threads per block: **1024**

Max thread dimensions xyz: **(2048, 2048, 64)**

Max grid dimensions xyz: **(65536, 65536, 65536)**

Total threads:

**$1024 * 2048 * 2048 * 64 * 65536 * 65536 * 65536$**

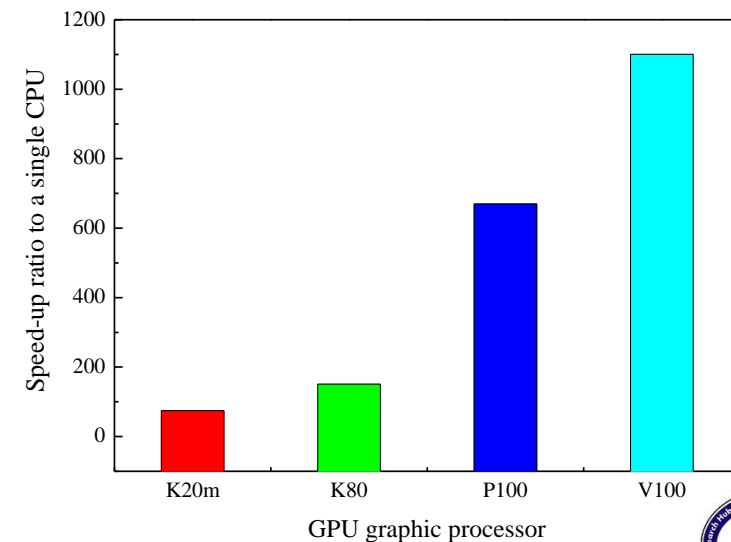
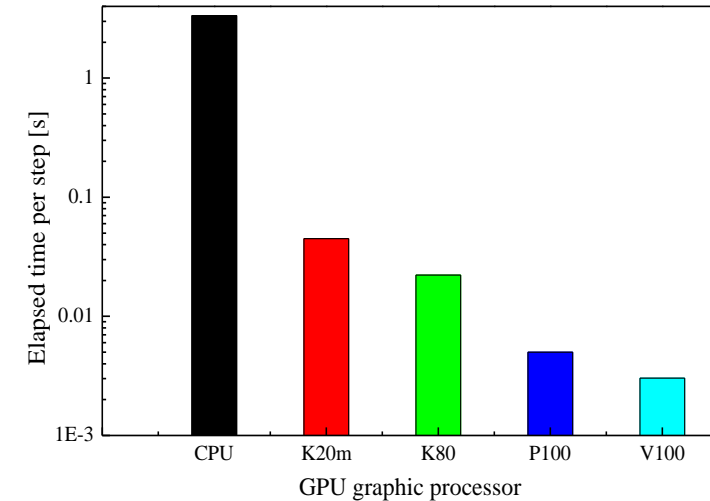
# GPU - DEM

Specification of different GPU graphic processors

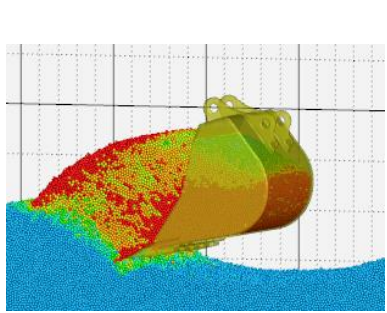
Model name	Tesla K20m (UNSW)	Tesla K80 (Massive 3)	Tesla P100 (Massive 3)	Tesla V100 (Massive 3)
Memory clock, GHz	2.6	5	715	876
Maximum band width, GB/s	208	480	732.2	897.0
Peak performance of double precision, TFlops	1.17	2.91	4.763	7.066

For the **homogenous** case of packing in a rectangular box with 300,000 spheres :

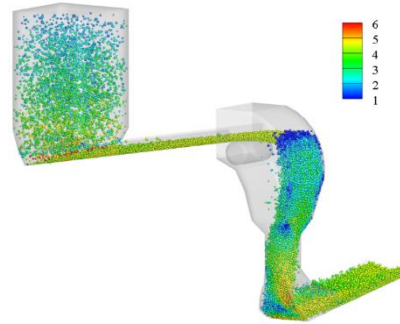
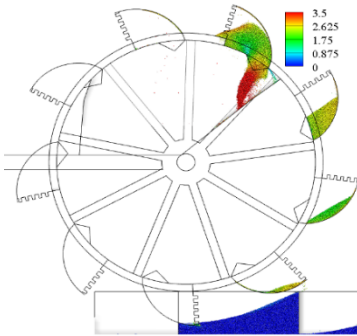
**Speed-up ratio of V100 to a single CPU >1000 times**



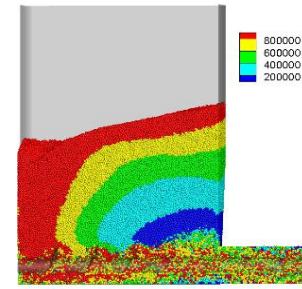
# Whole process scale: Application of GPU-DEM from mine site to blast furnace [1]



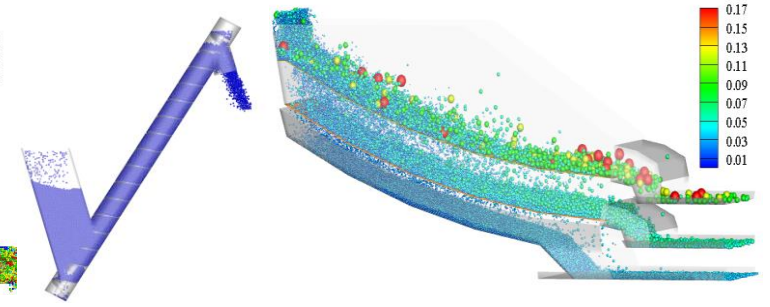
Excavating / Reclaiming



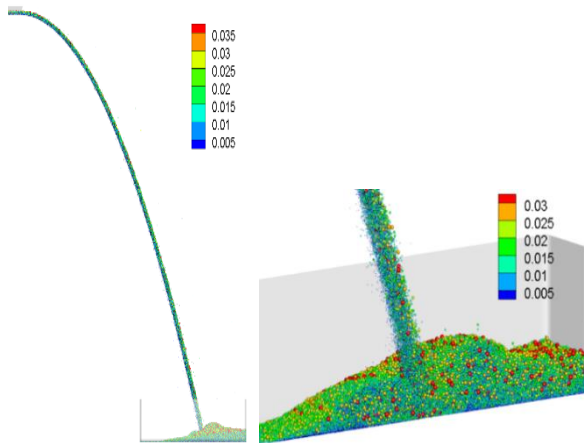
Belt conveying



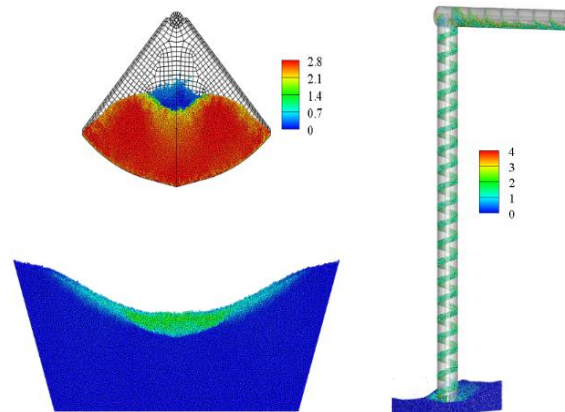
Screw conveying



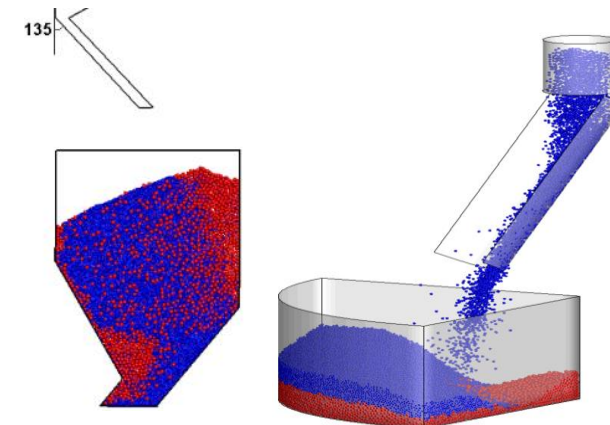
Screening



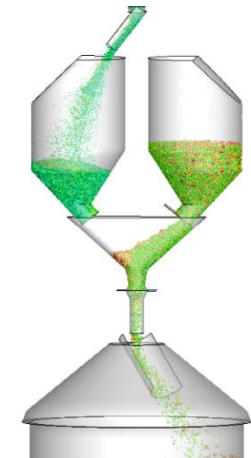
Ship loading



Ship unloading

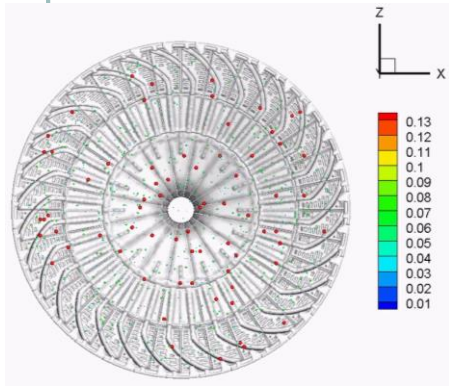


Hopper flow / BF top charging

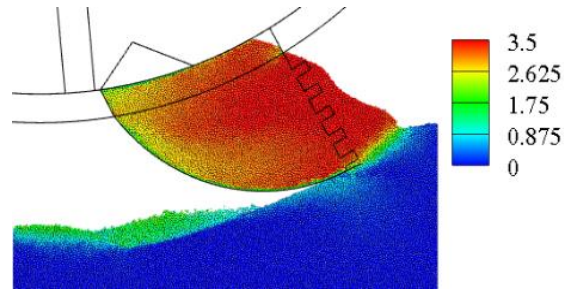


[1]. J. Gan, T. Evans, A. Yu, Application of GPU-DEM simulation on large-scale granular handling and processing in ironmaking related industries, Powder Technology, 361 (2020) 258-273.

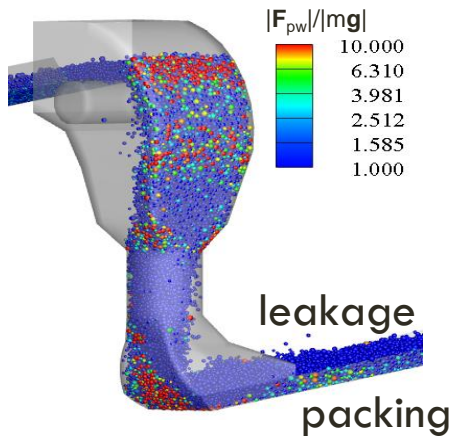
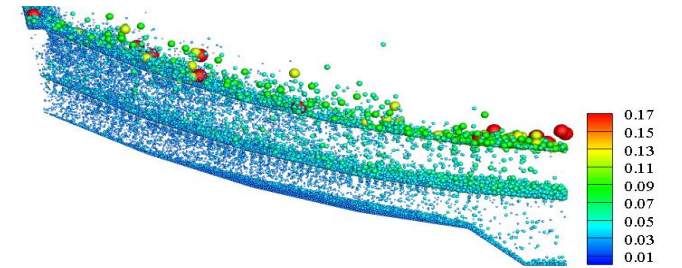
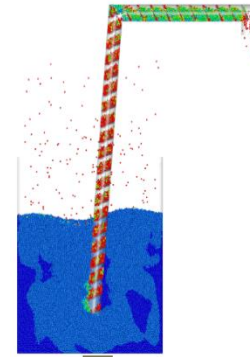
# Process performance and efficiency



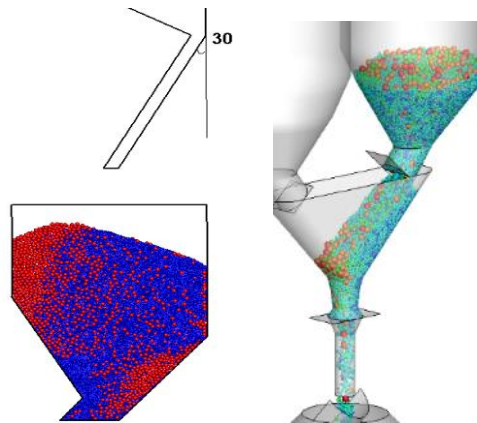
Particle behavior



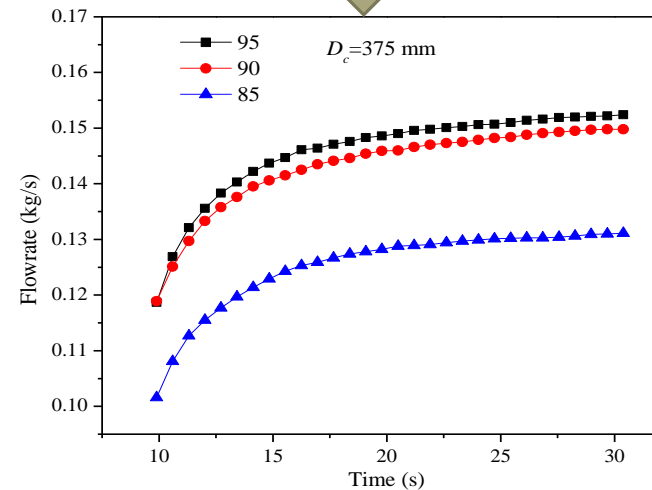
Particle dynamics



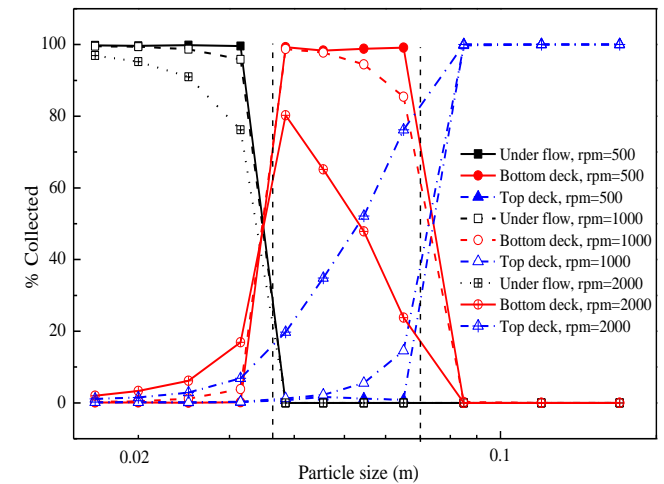
Smoothness



Segregation



Mass flow rate

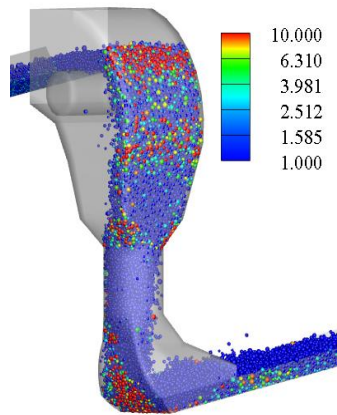


Screening efficiency



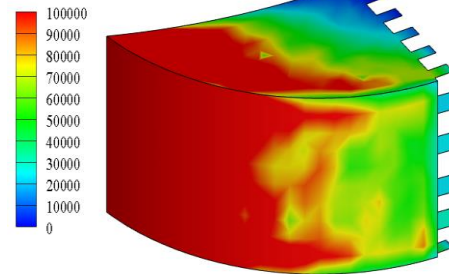
# Wall stress / particle-wall forces / wear

## Particle-wall forces

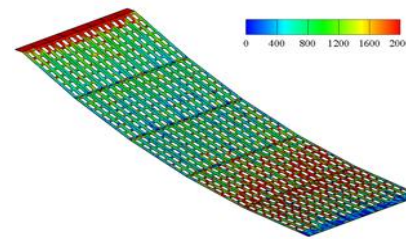


Conveyor transfer chute

## Wall stress

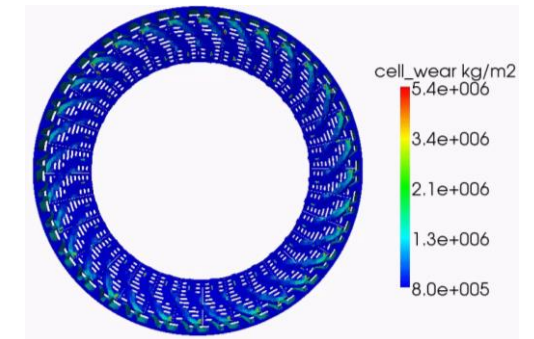


Reclaimer bucket



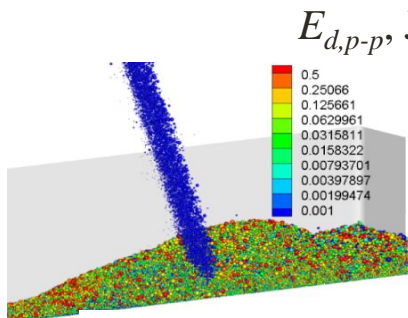
Double deck banana screen

## Wear

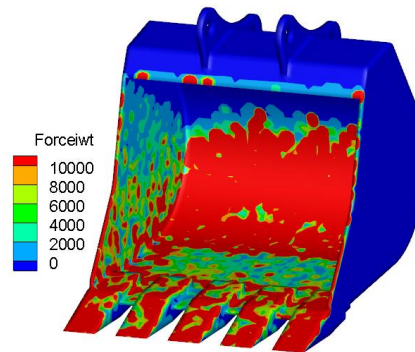


Finnie wear weight

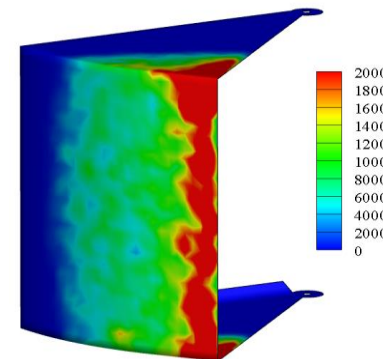
## Energy dissipation



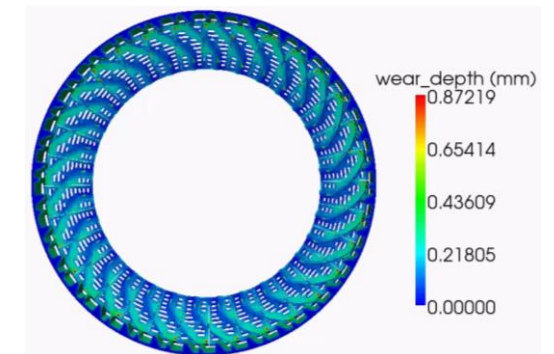
Ship loading



Excavator bucket



Grabs



Archard wear depth