

# Weekly Meeting

## Week 5

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## Lesson Learned from Arnold Nicholas's Thesis

The research explored the integration of DL architecture, e.g. CNN and point-based networks and addressing the challenge of segmentation algorithms.

### Challenges

- Processing 3D point cloud can pose significant computational demands, mainly when dealing with complex and dense scene.
- the absence of GPU strongly influenced the research direction and methodology.
- DL typically require extensive memory and processing power, not viable without GPU

## Summarising Arnold's Outcome

- **Outcome** : Geometric-Partitioning and eXplainable Point Cloud Classifier (GeoPart-XPCC)
- **Data Preprocessing**: Min-Max Normalisation, L2 Normalisation
- **Algorithms and Heuristic**: Greedy Algorithm, Incremental Algorithm, Feedforward Algorithm, **Supervised Learning, Classification, Unsupervised Learning, Clustering, Point Cloud Segmentation**

- [illegible]

### Figure 1: LiDAR Exploration Issue

## Bernoulli's Equation

[1] Water Channel Pressure

$$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant} \quad (1)$$

$$P_1 + \underbrace{\frac{1}{2}\rho v_1^2}_{\text{kinetic energy}} + \underbrace{\rho gh_1}_{\text{potential energy}} = P_2 + \underbrace{\frac{1}{2}\rho v_2^2}_{\text{kinetic energy}} + \underbrace{\rho gh_2}_{\text{potential energy}} \quad (2)$$

## Poiseuille's Law

[1] Poiseuille's law says that the flow rate  $Q$  depends on fluid viscosity  $\eta$ , pipe length  $L$ , and the pressure difference between the ends  $P$  but all these factors are kept constant for this demo so that the effect of radius  $r$  is clear.

$$\frac{Q = \pi r^4 P}{8\eta L} \quad (3)$$

## Permeability / Darcy Law [2]

$$Q = -KA \frac{dh}{dx} \quad (4)$$

where  $K$  is the hydraulic conductivity and  $\frac{dh}{dx}$  is the hydraulic gradient.  $Q$ , the total discharge rate, has units of  $\frac{m^3}{s}$ , the volume of water per time. The negative sign is due to the fact that the fluid flows down (negative) the hydraulic gradient from higher values to lower values.

## Hydraulic Conductivity

[3] The hydraulic conductivity is a physical parameter that accounts for how easily the fluid can move through the pore space for the material.

$$K = k \frac{\gamma}{\eta} \quad (5)$$

where  $k$  is the intrinsic permeability of the porous media (the solid),  $\eta$  is the dynamic viscosity of the fluid, and  $\gamma = \rho g$  is the specific weight of the fluid, which depends on the fluid density,  $\rho$  and gravity,  $g$ .



## Soil shrinkage/swelling [2]

$$r_s = \ln \frac{V_i}{V_0} / \ln \frac{z_i}{z_0} \quad (6)$$

where  $V$  and  $z$  are the volume and height of the soil, with the subscript 0 being the initial conditions and subscript  $i$  representing the  $i$ th step.

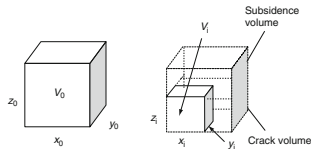


Figure 2: Volume change in vertical and horizontal direction by soil shrinkage.

$$q_f = s_u \cdot N_{cu} + q_o$$
$$N_{cu} = N_c \cdot s_c \cdot d_c$$

where  $s_c$  is a shape factor and  $d_c$  is a depth factor.



## Reference

- [1] JJB Bronswijk. “Shrinkage geometry of a heavy clay soil at various stresses”. In: *Soil Science Society of America Journal* 54.5 (1990), pp. 1500–1502.
- [2] James Kenneth Mitchell, Kenichi Soga et al. *Fundamentals of soil behavior*. Vol. 3. John Wiley & Sons New York, 2005.
- [3] Gopal Ranjan and ASR Rao. *Basic and applied soil mechanics*. New Age International, 2011.