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DISCRIMINATOR ALGORITHM FOR ASSESSING COMPRESSIVE AND TENSILE STRENGTH IN 3D CONCRETE PROTOTYPING

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Abstract
This research used predictive model to sort out images from design blue print by simulation. This concept compares input image data parameters with geometrical shapes to match existing design standard. The assembly part of the frames is uploaded on software to address spot with likely collapse tendency. This outcome was used to minimize failure in three-dimension concrete. The algorithm extracts three-dimension images using fuzzy logic and haptic feedback system to reduce micro crack defects in concrete molding.
Keywords: Discriminator, Algorithm, Compressive, Tensile, Concrete.

Introduction
Generative algorithm plays a significant role in artificial intelligent and machine learning. This idea was used in coding parametric design dataset to solve complex problem in building concrete foundation step by step. The conventional method of building a structure is not reliable when calculating ratio of water, cement and additives to be used. Power equation was used to track split mold when temperature increases due to axial load which decreases in flexural strength (Ahmed et al., 2016). Compressive stress involves response from concrete to resist external load when pressed. This condition is accompanied by decrease in frame length which is not proportional to beams cubic expansion (Madandoust et al., 2017). Tensile stress is a condition whereby concrete repel exerted load. An experimented work criterion was used to measure yield strength and modulus of elasticity to reinforced bond of composite materials (Nicolas, 2018). The curing time and proportion of calcium silicate hydration has to be stabilized within thermal gradient and hardening of concrete fragments. Concrete performance was further analyzed using velocity solvent flow, curing time and analytical geometry simulation (Suiker, 2018). Weight aggregate grading of concrete shows that soil texture and moisture content relatively have impact on curing time (Chhorn & Lee, 2018). Fatigue strength correlation shows that decrease in heat flux increases compressive stress and creep formation (Shu et al., 2011). Upward flow of water inside concrete is a serious problem to be corrected using flow sensors. Concrete subjected to high static loading respond more to lateral crack due to inconsistent surface dryness and temperature profiling (Khan & Iqbal, 2023).

Material And Method
The material used for this research consist of limestone mixed with ethylene vinyl acetate 0.07 nm scale. An ultrasonic velocity pulse instrument was also used for signal transduction process. Previous study uses ABAQUS software to match blur concrete image samples to test resilient of materials

physical and mechanical properties (Shakor et al., 2021). The efficacy relied on self- healing for composite matrix bond formation. This were evaluated based on air flow, homogeneity and segregation inside the mixer heating chamber. Sampling frequency was adjusted from 15khz to 60 khz to sustain 4.31 velocity pulse rate at 10 seconds intervals. The three dimension (3D) concrete has a ratio of 1.1.0.8 composition of cement, water and additive in 10mol/dm^3 concentration. While the binder viscous flow was captured by three-dimension (3D) crack strata with thickness 1.5mm and width up to 4.3m. The concrete block was preloaded for scikit learning as shown in table 1.0 below. The model was expected to sense direction of strain at dimension 2.6mm by 2.6mmby 12 mm acting as discriminator. Open computer vision was created to match scan designed three-dimension (3D) concrete. The outcome produces two fake images and four real images with 2.12 integrity of index in figure 1.10 below. Curing temperature and water retention were measured with sensing devices like water level and thermal sensor positioned at specific depth when concrete become void in strength. Prediction was made using ash binder placed at the concrete bottom with a precise shape and size (Siddique et al., 2011). Stress increases in an irregular mold due to axial load and lateral contraction in concrete joints (Mei et al., 2018).

Result And Discussion

The data in table 1.0 below shows compressive and tensile strength for non-destructive concrete test using ultrasonic pulse velocity (UPV) image mapping detection. This approach was used to quantify areas with low, medium and high integrity index. It shows that in table 1.0 below, grain growth in reinforced concrete tend to increase at the middle and extreme in concrete column. At 1.51 integrity index shows increasing elasticity modulus value reading from 1.33 to 2.20 increment in pascal (pa). There was inconsistent curing temperature with low additive hardening which increases the concrete creep formation. Whereas, value at 1.50 integrity index and elasticity modulus of 2.20 pascal (pa) is more to tensile strength. As the pulse velocity tend to reach higher crack speed up by exciting the atoms of the composite materials boundary. As decrease in compressive strength moves from 0.01 Mpa and slightly the tensile strength has nominal strength of 0.02 Mpa in table 1.0 below.

Table 1.0 Micro Crack Test using Ultrasonic Pulse Velocity Imaging

Load (N)	Area (m^2)	Compressive Strength (Mpa)	Tensile Strength (Mpa)	Elasticity Modulus (pa)	Integrity Index
30.10	20.00	06.22	0.50	7.00	1.91
47.20	27.02	15.00	1.10	4.31	2.12
12.33	12.06	1.03	7.03	1.33	1.51
28.06	18.22	0.02	12.33	2.20	1.50
7.30	26.11	0.01	0.03	01.00	1.50

Tensile strength with positive and negative curve has reached maturity fatigue life and swift in time of wave travel. Specimen with reinforced glass alloy has pulse velocity of 7 m/s at a time of travel 0.5 seconds. This shows early maturity fatigue life and stable cyclic loading which decreases with steep microcrack initiation at 4.3 m/s and 1.5 seconds (pulse velocity and time of wave travel). Stiffness affects the crystal lattice which increases intermolecular bond with intense contractions. In figure 1.1, shows that upper critical point of 12.33 pulse velocity has time travel from 0.01 seconds for compressive and 0.03 seconds for tensile flexural deflection. That is, the amplitude forms discrete and continuous time attenuated signal. The algorithm only picks point figure 1.0 below break-even point at 3.60 pulse velocity with 1.76 second as concrete demodulate signal acquisition.

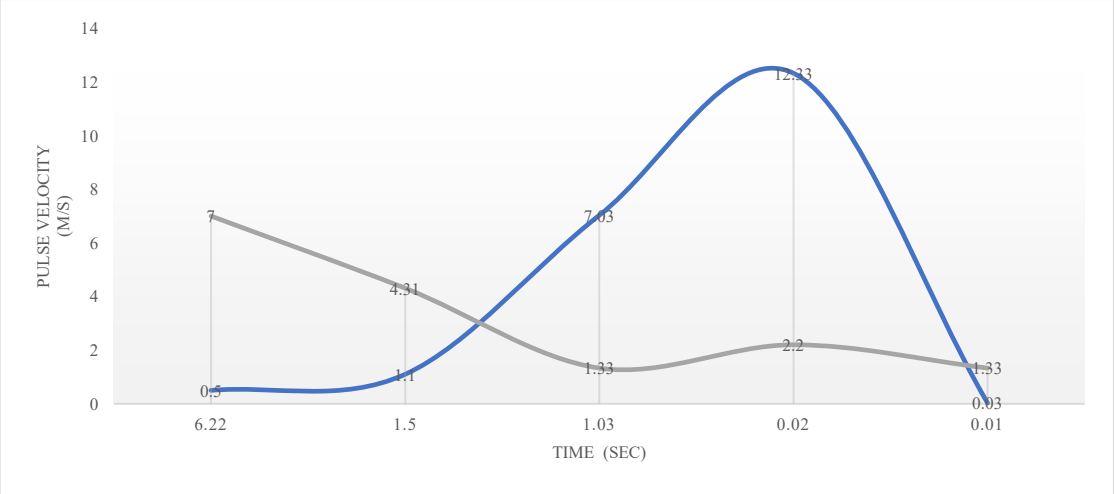


Figure 1.0 Structural frame Pulse velocity with Time continuous signal Slope

Conclusion

This research tends to develop comparative algorithm to act, sense and track solid structures. The principles provide explainable artificial intelligence by judging digitally error in image design before accomplishing the physical building with least shelf life.

Recommendation

This research requires haptic feedback and 4-wheel robot to remotely detect microcrack and refill spot with dispensing splash motion mixer load. This technique converts images into virtual score card for investigate blueprint integrity.

References

Ahmed, M., Mallick, J., & Hasan, M. A., (2016). A study of factors affecting the flexural tensile strength of concrete. *Journal of King Saud University-Engineering Sciences*, *28*(7), pages, 147-156. https://doi.org/10.1016/j.jksues.2014.04.001

Chhorn, C., & Lee, S. W., (2018). Influencing compressive strength of roller-compacted concrete. *Proceedings of the Institution of Civil Engineers-Construction Materials*, *171*(1), pages, 3-10. https://doi.org/10.1680/jcoma.16.00009

Khan, M.M, & Iqbal, MA., (2023). Strain rate and size effects on dynamic compressive behaviour of standard and high-strength concrete. Materials and Structure, 56(11), page,176. https://doi.org/10.1617/s11527-023-02266-x

Mei, Li., Hong H., Yanchao, S., & Yifei H., (2018). Specimen shape and size effects on the concrete compressive strength under static and dynamic tests.Construction and Building Materials.161(2), pages,84-93. https://doi.org/10.1016/j.conbuildmat.2017.11.069

Madandoust, R., Kazemi, M., &Yousefi M.S., (2017). Analytical study on tensile strength of concrete.In *Revista Romana de Materiale, 2* (2), pages, 204-209 https://hdl.handle.net/2268/250280

Nicolas, R., (2018). Rheological requirements for printable concretes Journal of Cement and Concrete Research,112(10), pages76-85.
https://doi.org/10.1016/j.cemconres.2018.04.005

Shu, X., Haung,B., Wu, H., Dong, Q., & Burdette, E.G, (2011). Performance comparison of laboratory and field produced pervious concrete mixtures. Construction and Building Materilas,25(8), pages, 3187-3192.
https://doi.org/10.1016/j.conbuildmat.2011.03.002

Suiker, A.S.J., (2018). Mechanical performance of wall structures in 3D printing processes: Theory, design tools and experiments. International Journal of Mechanical Sciences,137(3), pages, 145-170.
https://doi.org/10.1016/j.ijmecsci.2018.01.010

Shakor, P., Gowripalan, N., & Rasouli, H., (2021). Experimental and numerical analysis of 3D printed cement mortar specimens using inkjet 3DP.Archives Civil and Mechanical Engineering, 21 (3), page 58.

https://doi.org/10.1007/s43452-021-00209-3

Siddique, R., Aggarwal, P., & Aggarwal, Y., (2011). Prediction of compressive strength of self-compacting concrete containing bottom ash using artificial neural networks.*Advances in engineering software*, *42*(10), pages,780-786.
https://doi.org/10.1016/j.advengsoft.2011.05.016