Appendix for:

Compressive strength prediction and optimization design of sustainable concrete based on squirrel search algorithm-extreme gradient boosting technique

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Appendix

Table A Algorithm parameters and optimal parameters of models

algorithm	algorithm parameters	optimal XGB parameters
CHOA	none	Min_child_weight = 0.7699 Learning rate = 0.4817 Num_trees = 255.3345
GJO	*c1* = 1.5, which influences the prey energy β = 1.5, which is related to Levy function partition coefficient = 3, which influences the position update of jellyfish	Min_child_weight = 1.4662 Learning rate = 0.2523 Num_trees = 764.8935
JS	coefficient of motion = 0.1, which influences the movement of jellyfish η = 4.0 which influences the initialization	Min_child_weight = 4.2473 Learning rate = 0.5009 Num_trees = 716.9580
SCSO	none	Min_child_weight = 0.6996 Learning rate = 0.3242

		Num_trees = 285.0761
SSA	ST = 0.6, i.e., alert value PD = 0.7, i.e., proportion of discoverers; rest are the participants SD = 0.2, i.e., proportion of sparrows aware of danger	Min_child_weight = 2.5580 Learning rate = 0.3773 Num_trees = 574.2193
GA	pc = 0.7, i.e., cross probability pm = 0.3, i.e., mutation probability	Min_child_weight = 1.7082 Learning rate = 0.3399 Num_trees = 486.6444

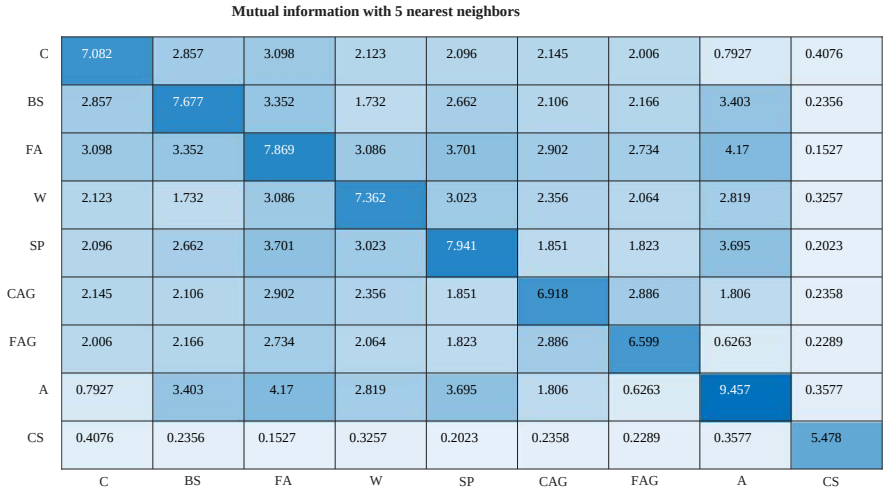


Fig. A Mutual information of different variables by 5 nearest-neighbors method.

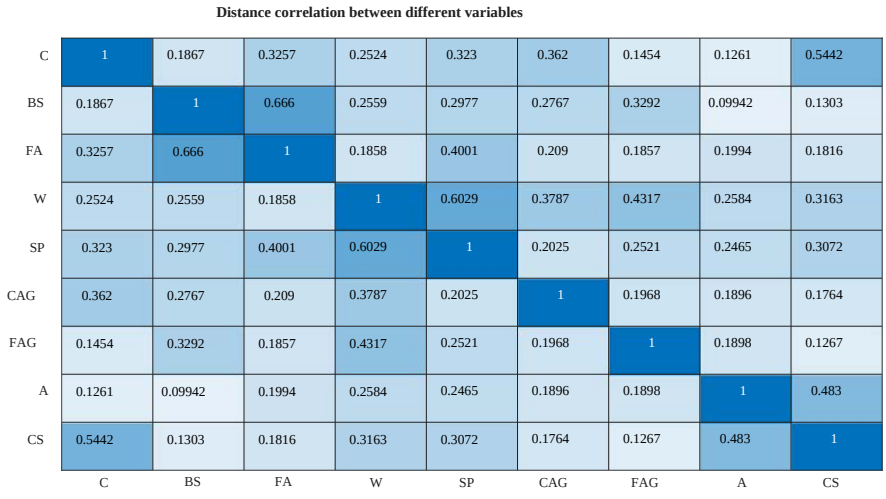


Fig. B Distance correlation between different variables.

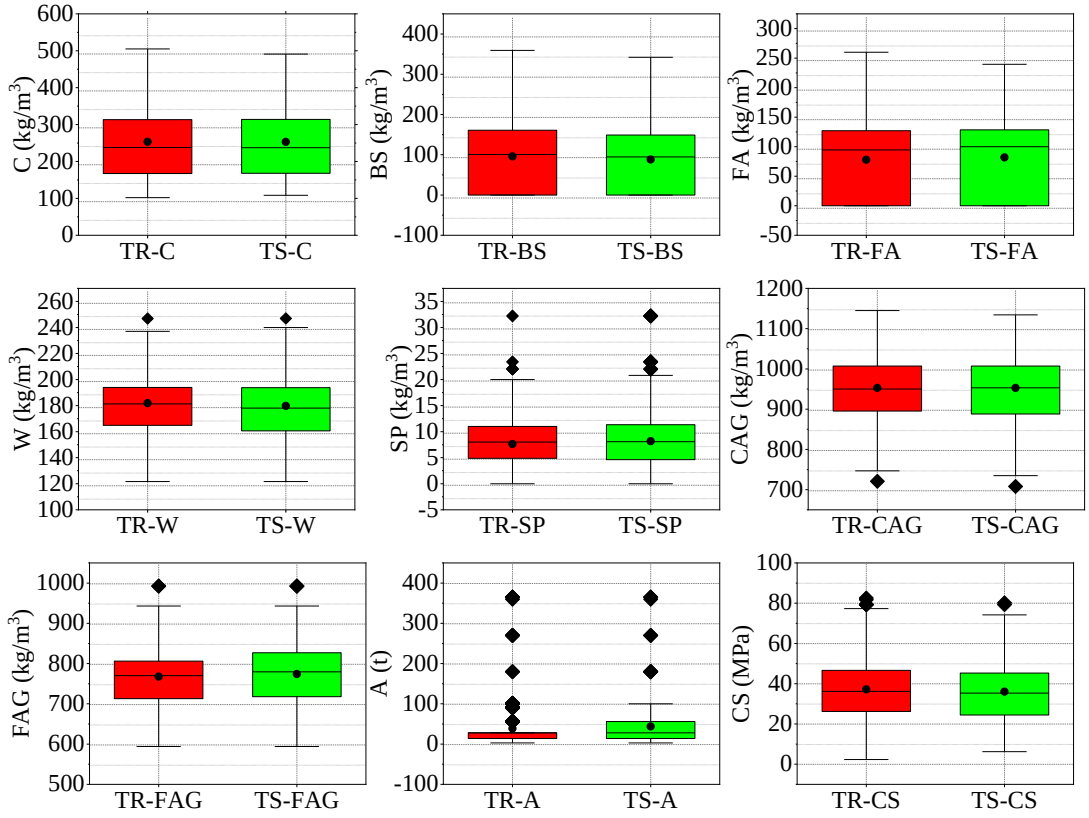


Fig. C Comparison of general data distribution of the training set (TR) and testing set (TS).

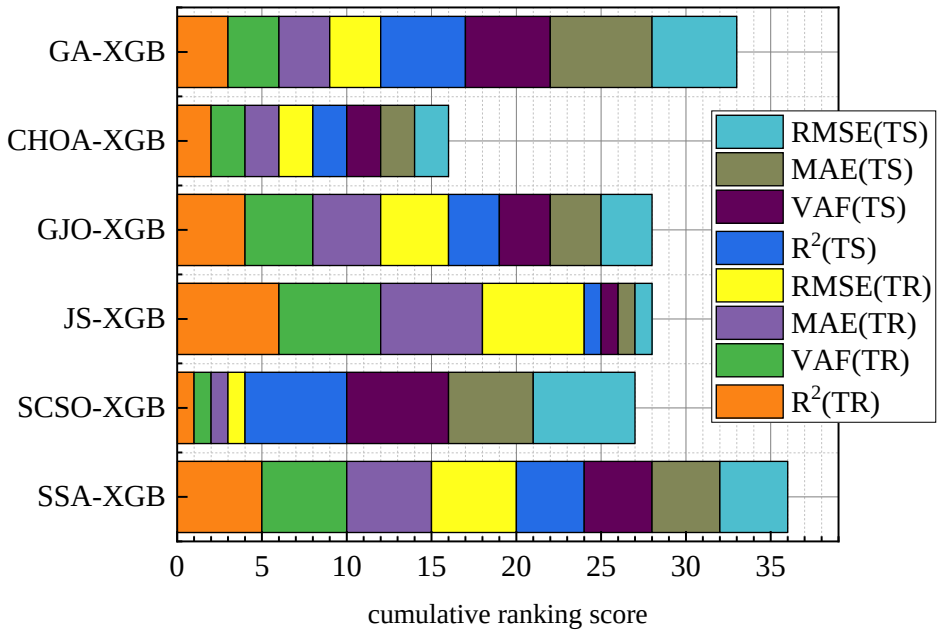
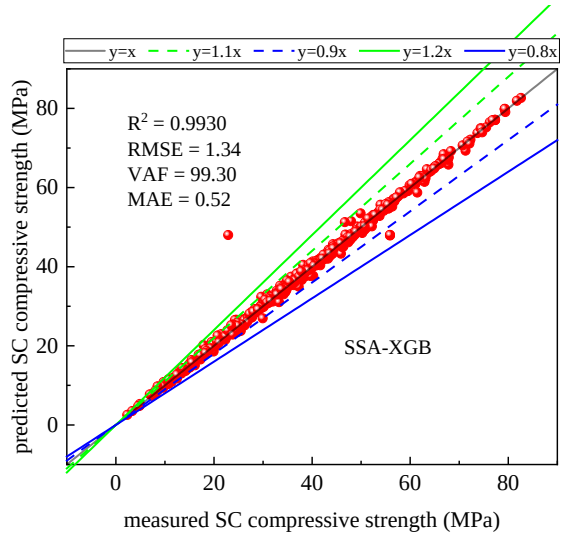
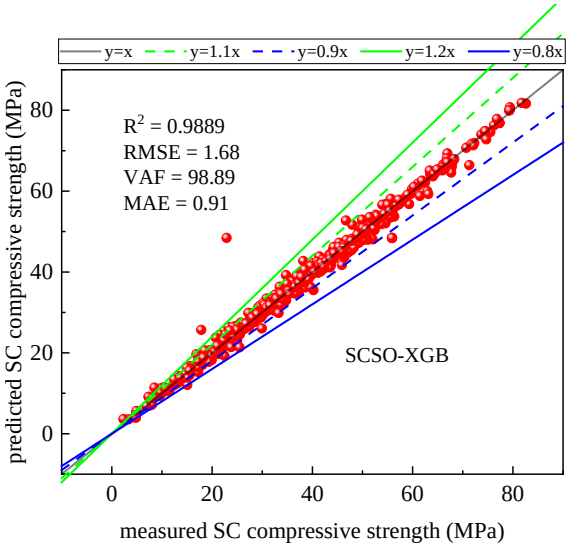
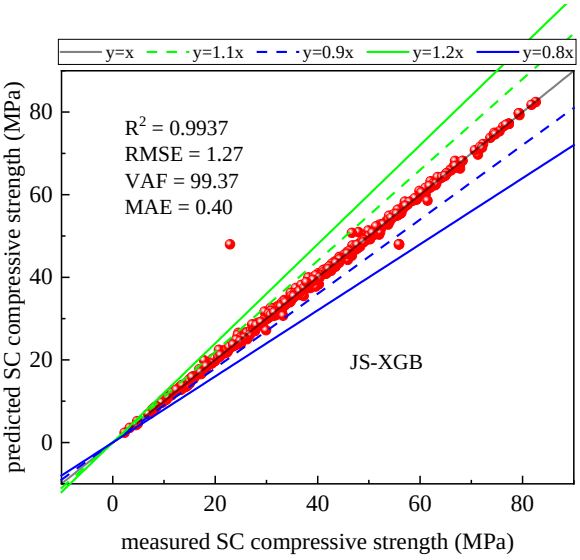


Fig. D Intuitive display of comprehensive score of five hybrid XGB models.


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R2 = 0.9930
RMSE = 1.34
VAF = 99.30
MAE = 0.52
SSA-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
20
40
60
80


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R2 = 0.9889
RMSE = 1.68
VAF = 98.89
MAE = 0.91
SCSO-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
20
40
60
80


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R2 = 0.9937
RMSE = 1.27
VAF = 99.37
MAE = 0.40
JS-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
20
40
60
80

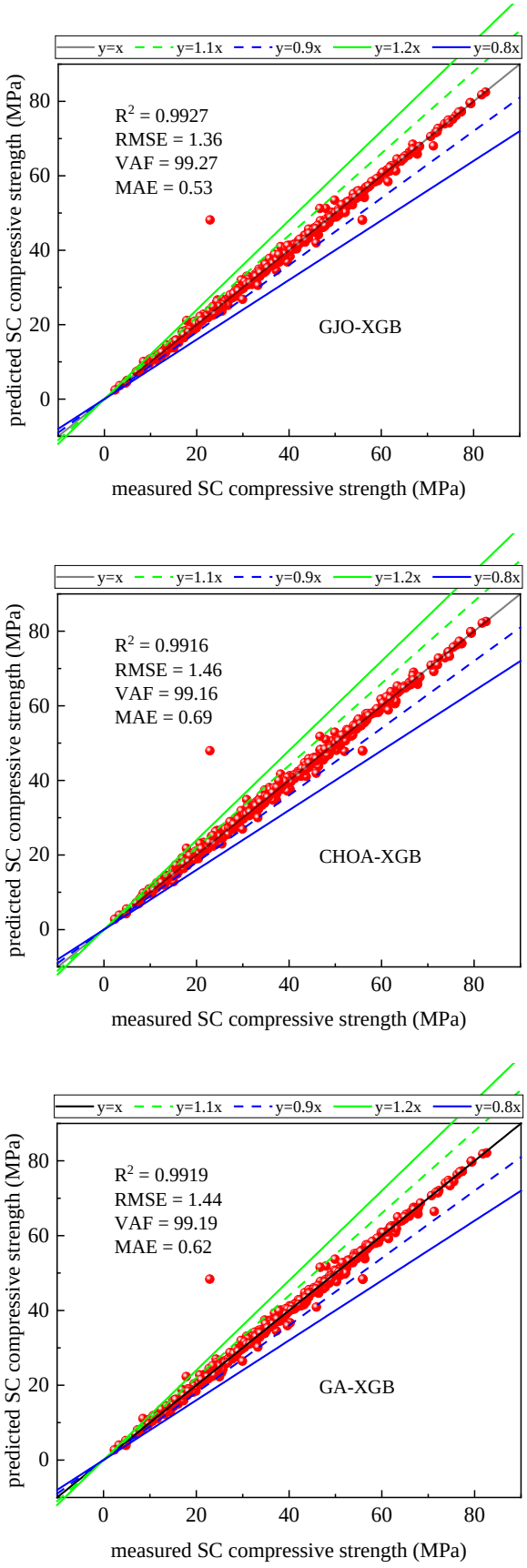
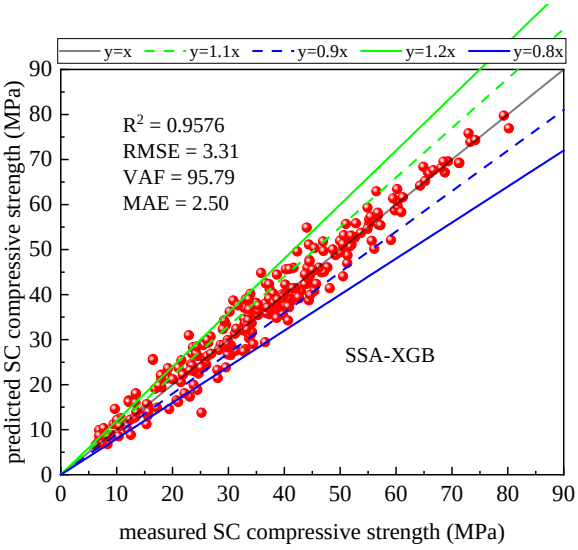
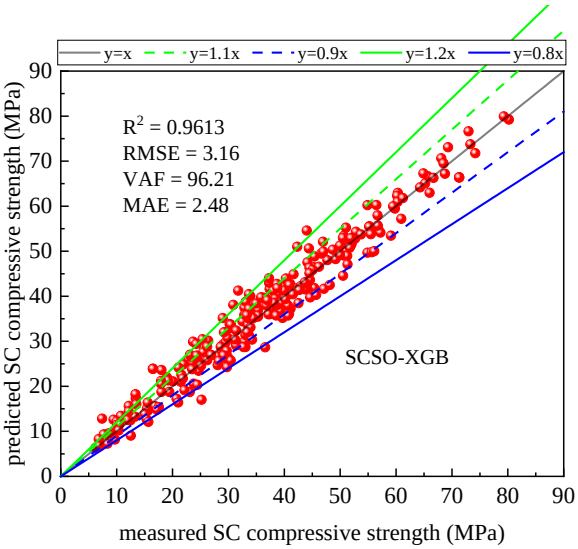
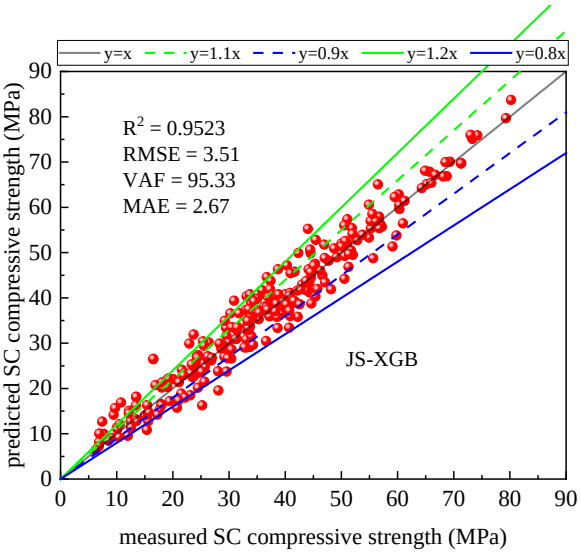


Fig. E Comparison between predictive values and actual values of the training dataset.


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R² = 0.9576
RMSE = 3.31
VAF = 95.79
MAE = 2.50
SSA-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
10
20
30
40
50
60
70
80
90


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R² = 0.9613
RMSE = 3.16
VAF = 96.21
MAE = 2.48
SCSO-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
10
20
30
40
50
60
70
80
90


y=x
y=1.1x
y=0.9x
y=1.2x
y=0.8x
R² = 0.9523
RMSE = 3.51
VAF = 95.33
MAE = 2.67
JS-XGB
predicted SC compressive strength (MPa)
measured SC compressive strength (MPa)
0
10
20
30
40
50
60
70
80
90

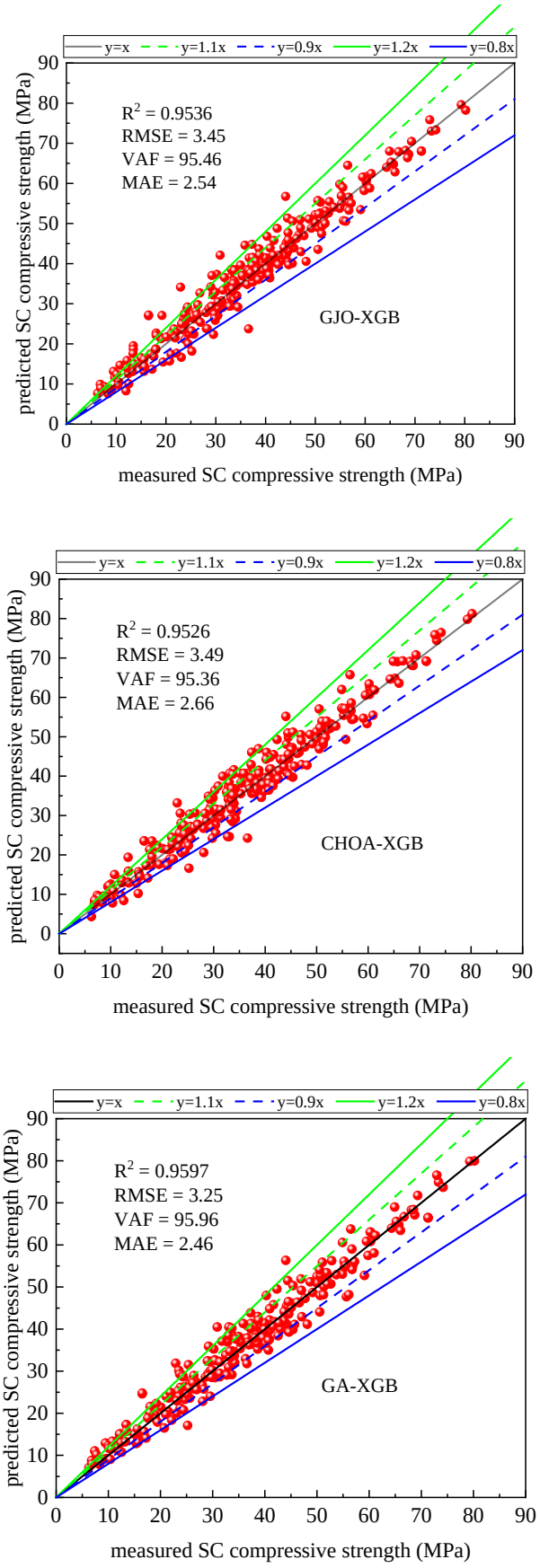


Fig. F Comparison between predictive values and actual values of the testing dataset.