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Rockfill dam compaction quality evaluation based on cloud-fuzzy model

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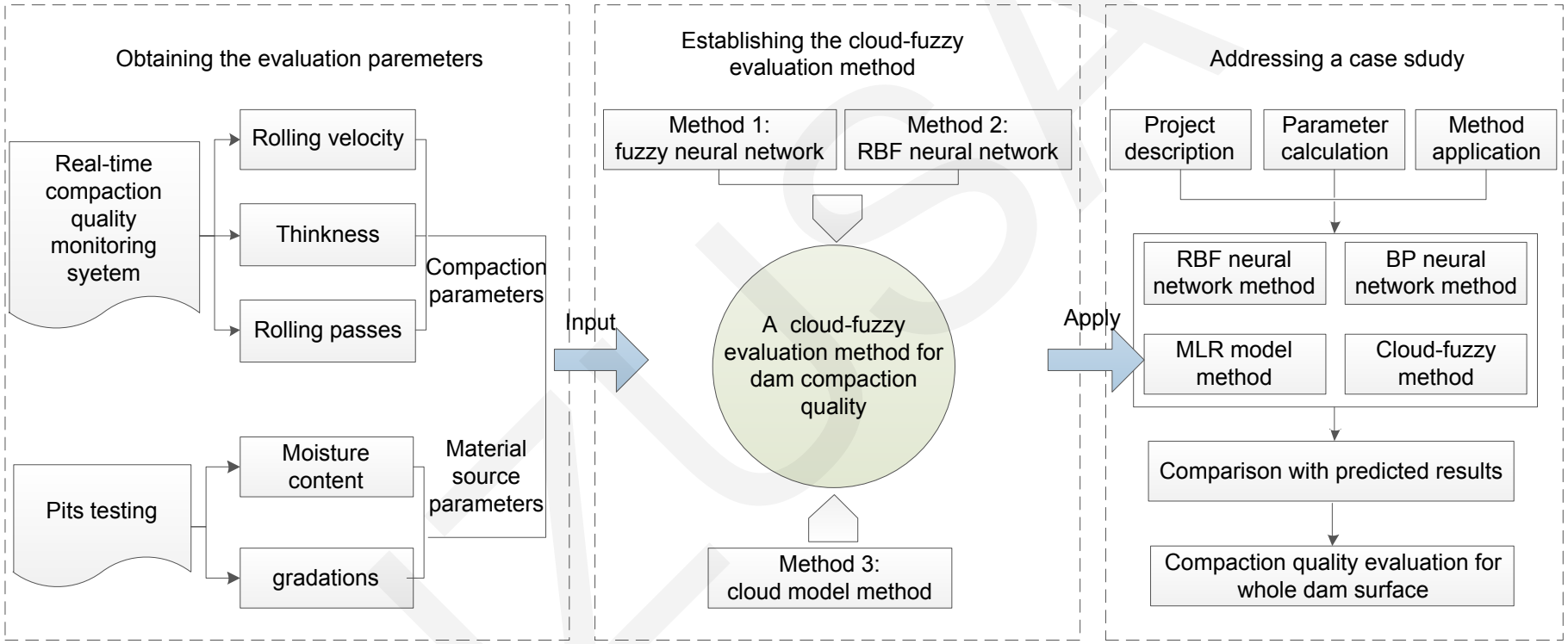
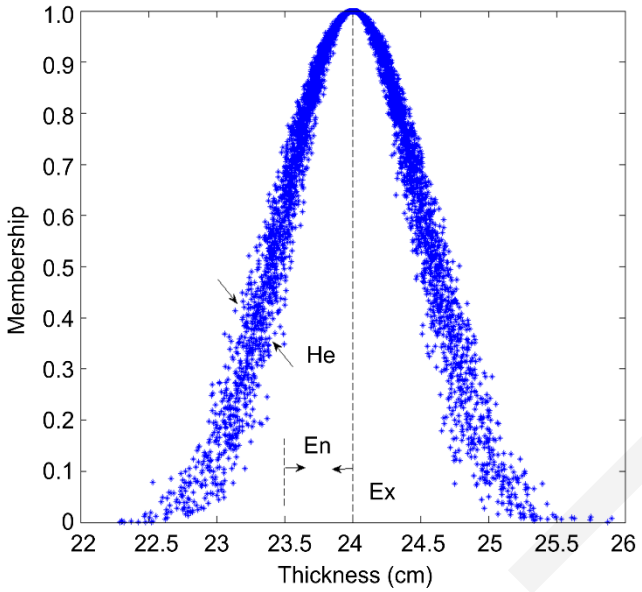
Framework of proposed methodology

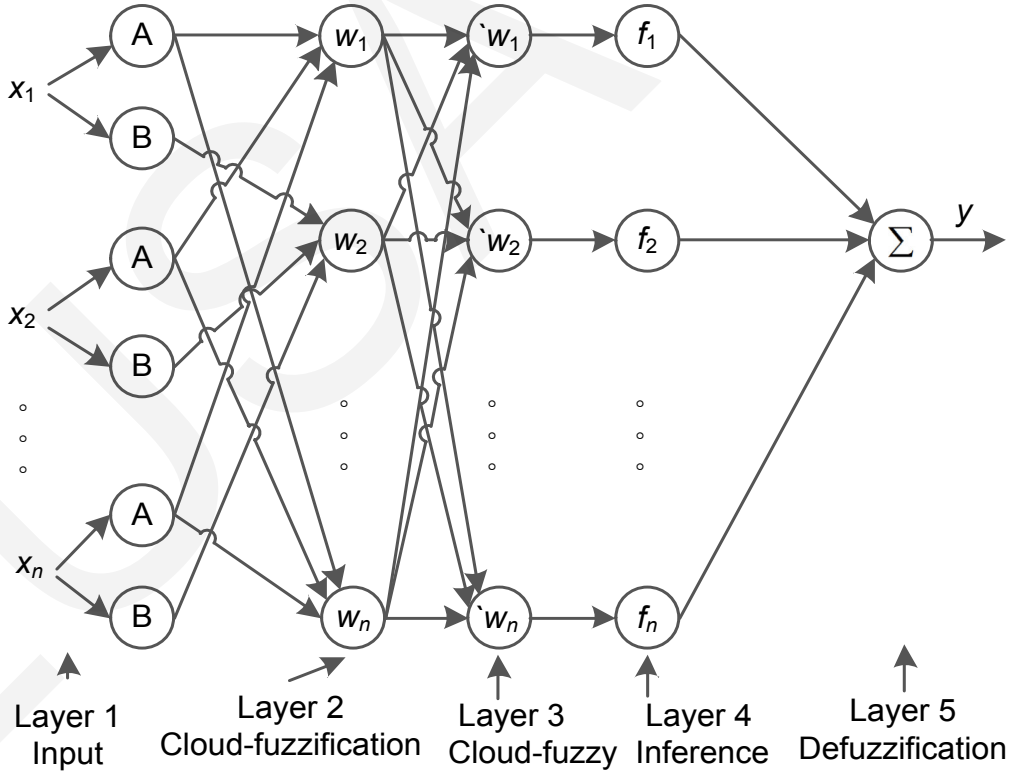


Framework of proposed methodology

Cloud-fuzzy model

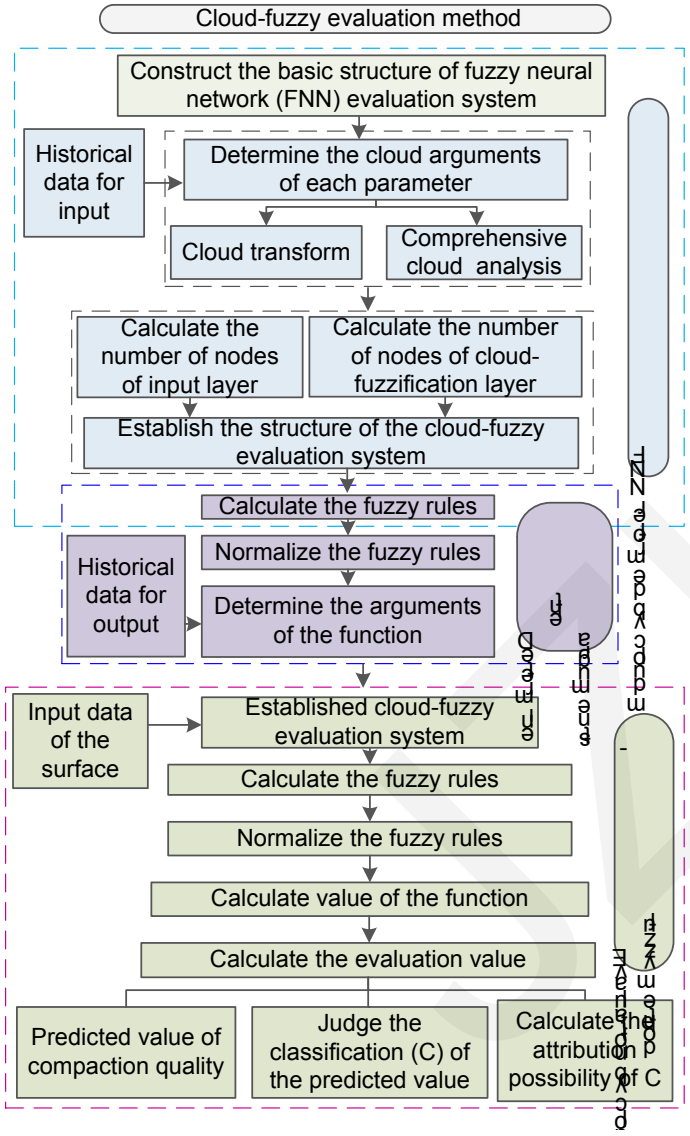


Cloud concept of thickness (Ex=24 cm, En= 0.5085 cm, He=0.0578 cm)



Cloud-fuzzy model

Procedures for evaluation of compaction quality based on cloud-fuzzy method

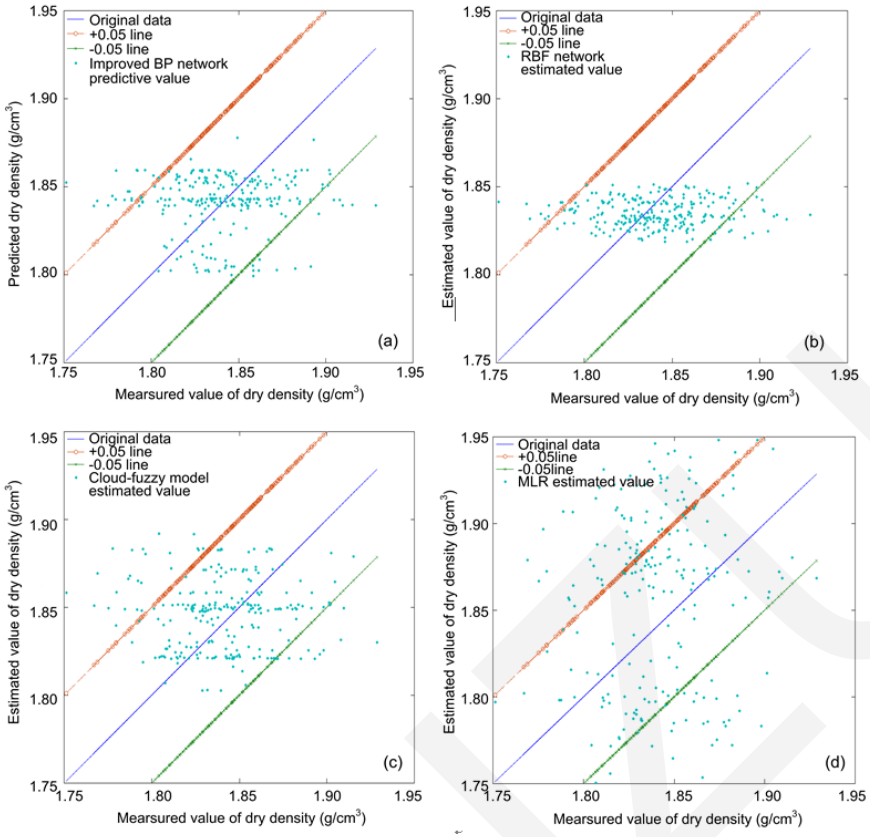


$$C_{\mu}(x) = \max(C_{I\mu},\ C_{II\mu},\ C_{III\mu}),$$

$$P(x) = \begin{cases} 1-\phi_{I}(x), & x \in I, \\ \phi_{II_1}(x), & x \in II,\ x \le \mathrm{Ex}_{II}, \\ \phi_{II_2}(2\mathrm{Ex}_{II}-x), & x \in II,\ x > \mathrm{Ex}_{II}, \\ \phi_{III}(x), & x \in III, \end{cases}$$

Detailed procedures for the cloud-fuzzy evaluation of compaction quality

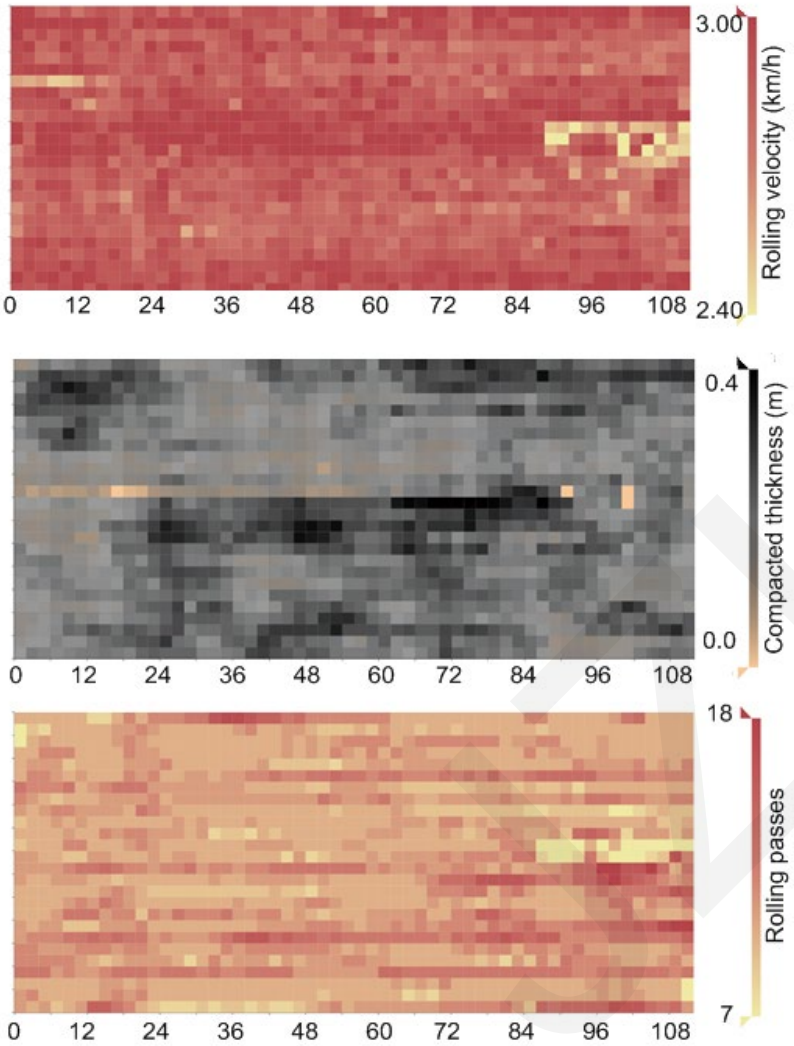
Rationality analysis of the cloud-fuzzy models



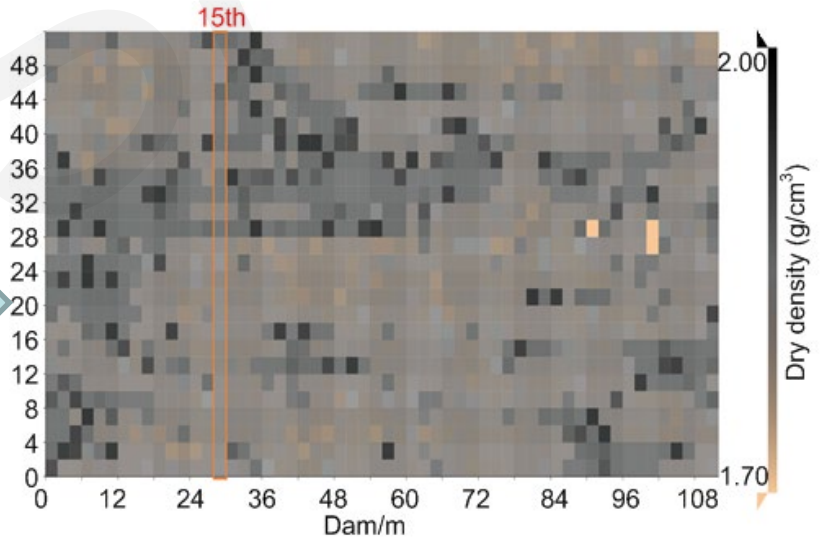
- the cloud-fuzzy model is based on overall sample distribution.
- The improved BP neural network, RBF neural network, and MLR model are deterministic models; the cloud-fuzzy model is an uncertain model.
- The cloud-fuzzy model is effective for evaluating the quality of compaction.

Measured value and estimated value of different models

Compaction quality evaluation of whole dam surface



cloud-fuzzy model



Dry density prediction of whole dam surface

Surface division and compaction parameters statistical analysis

Conclusions

- The present cloud-fuzzy model takes into account the uncertain relationship between compaction and its factors. It can express the randomness and fuzziness of compaction, and can compensate for the sole focus on precision by traditional approaches. The present model brings compaction evaluation more into line with objective rules.

- a triple-indicator method was proposed for evaluating the compaction quality. Not only can this provide the value of dry density at any grid, it can also give membership and the probability of dry density belonging to a particular classification.