

Интеллектуальный метод выявления потенциала городского обновления на основе теории пространственного гена: Шанхай

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Аннотация: В фазе планирования на основе существующего фонда точное выявление потенциала обновления становится ключевым. Исследование использует данные крыш зданий Шанхая, извлекает морфологические показатели, выделяет семь типов пространственных генов с помощью гауссовой смеси и прогнозирует потенциал методом случайного леса.

Ключевые слова: пространственный ген; городское обновление; морфология зданий; гауссова смесь; случайный лес; Шанхай

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1 Исследовательский контекст

Городское обновление Китая переходит от расширения к тонкой оптимизации существующего фонда. Теория пространственного гена позволяет рассматривать морфологию застройки как измеримое выражение исторических и социальных траекторий.

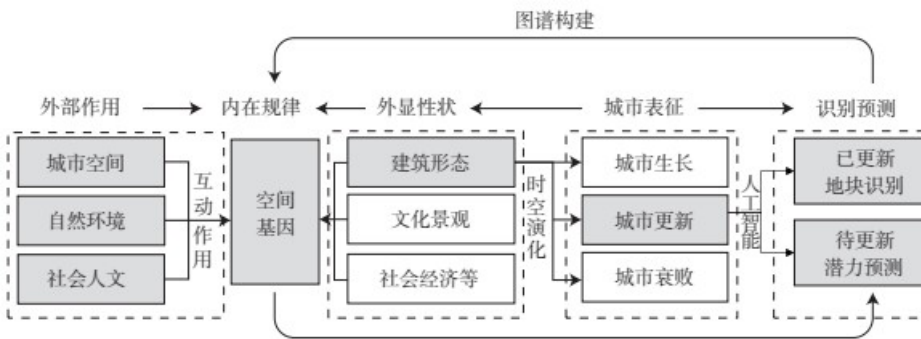


Рис. 1 Research framework

2 Обзор исследований

Морфологические исследования анализируют участки, улицы и здания, но часто остаются статичными. Работа вводит многолетние данные и машинное обучение для оценки динамики.

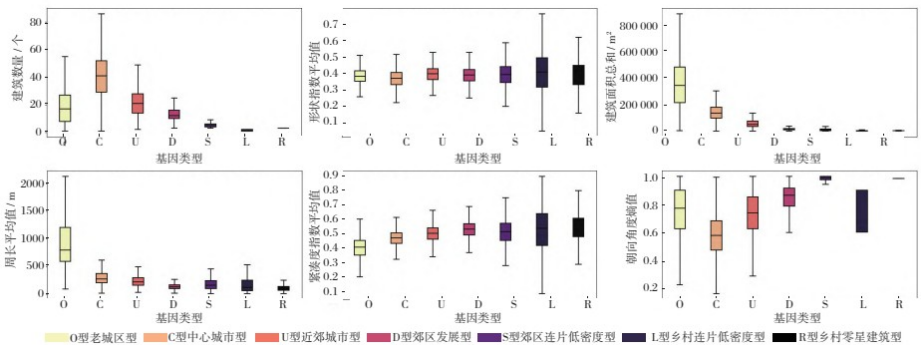


Рис. 2 Morphological characteristics of seven spatial-gene types in Shanghai, 2016

3 Морфология застройки Шанхая

Анализ охватывает весь Шанхай и данные крыш 2016-2021 гг. Используются шесть показателей: площадь, средний периметр, энтропия ориентации, индекс формы, компактность и число зданий.

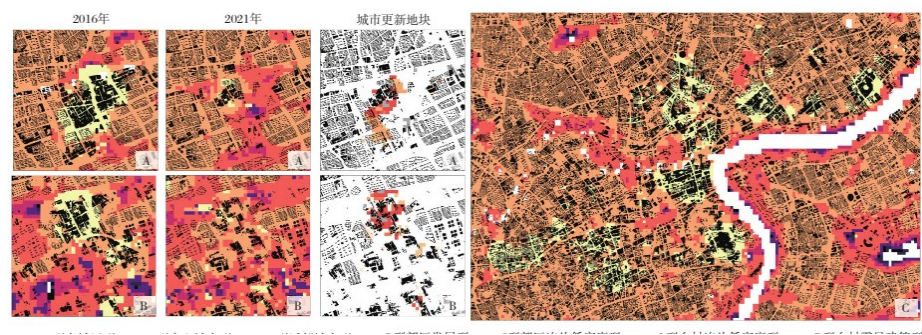


Рис. 3 Identified urban-renewal areas in Shanghai, 2016-2021

4 Выявление пространственных генов

Гауссова смесь выделяет семь типов от старого городского до рассеянного сельского. Переход участков от типа О к типу С трактуется как физическое обновление.

参数名称	设定值	取值范围
N_estimators	300	[100, 500]
Max_depth	None	[None, 20]
Max_features	'sqrt'	['sqrt', 'log2']
Min_samples_split	2	[2, 10]
Min_samples_leaf	1	[1, 5]

Таблица 1 Random forest parameters

5 Прогноз потенциала

Случайный лес показывает высокую точность. Ключевые факторы: площадь, расстояние до районных центров, периметр, возраст, центральность и цена жилья.



图4 特征重要性分布（左）和 SHAP 蜂巢图（右）

Рис. 4 Feature importance and SHAP beeswarm plot

6 Выводы

Высокий потенциал расположен между кольцами и в старых пригородных центрах. Метод поддерживает более точное и динамичное управление мегаполисом.



Рис. 5 Predicted renewal potential in representative districts

Tab.2 List of high-potential areas for urban renewal

区域	更新高潜力地区
浦东新区	三林镇、北蔡镇、祝桥镇
长宁区	虹桥街道、程家桥街道、华阳路街道、江苏路街道
黄浦区	小东门街道、老西门街道、南京东路街道、瑞金二路街道
普陀区	真如镇街道、桃浦镇、长风新村街道、长寿路街道
静安区	天目西路街道、大宁路街道、共和新路街道、彭浦新村街道、静安寺街道、南京西路街道
虹口区	嘉兴路街道、广中路街道
杨浦区	江浦路街道、四平路街道、五角场街道
徐汇区	田林街道、漕河泾街道、龙华街道、徐家汇街道、天平路街道、湖南路街道
闵行区	华漕镇、七宝镇、马桥镇、梅陇镇、吴泾镇、莘庄镇、浦江镇
宝山区	大场镇、杨行镇、顾村镇、高境镇
松江区	中山街道、永丰街道、泗泾镇、新桥镇、车墩镇、九亭镇、洞泾镇
青浦区	香花桥街道、夏阳街道、华新镇、赵巷镇、徐泾镇
奉贤区	南桥镇
嘉定区	新成路街道、江桥镇、安亭镇、马陆镇
金山区	朱泾镇、金山卫镇
崇明区	城桥镇

Таблица 2 List of high-potential urban-renewal areas

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