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模糊地理实体不确定性综合描述研究

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摘要:从二型模糊的角度讨论了模糊地理实体的不确定性,基于空间数据的位置误差,利用模糊集的 λ -截集和圆误差带模型推导了模糊地理实体隶属度的误差模型,并给出了隶属度不确定性的度量方法,提出了用隶属度误差立方体来综合描述模糊点的不确定性。

关键词:模糊地理实体;二型模糊集;圆误差带;隶属度误差立方体

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地理信息中大量的空间数据既包含位置误差、模型误差,同时还具有地理实体本身的模糊性。在位置不确定性方面,一些研究人员综合考虑了矢量数据的模型误差和随机误差,建立了线元的综合不确定带^[1,2];基于信息熵理论,研究了矢量数据的误差熵带,建立了不等同的误差熵带模型^[3-5]。但是,基于信息熵的不确定性模型仍然属于统计不确定性,因为误差熵是基于概率密度函数推导出来的。这里的误差熵模型是一种基于统计理论的不确定性模型^[6]。

对于综合量化随机不确定性和模糊不确定性,文献[6]提出了一种矢量数据不确定性的混合熵模型。但是,目前概率熵和模糊熵的结合尚处于研究阶段,针对不同的应用,模糊熵、混合熵存在多种表达方式,因此,应用混合熵来度量空间数据的混合不确定性,首先需要寻找一种合适的度量空间数据混合熵的数学模型。经典模糊集在实际运用中带有较大的主观性,而二型模糊集考虑了隶属度的误差,因此,运用二型模糊集理论来研究模糊点、线、面的数学模型更具实际意义^[7]。

针对不同的研究和应用领域,目前已经提出了许多模糊熵函数,并扩展到模糊集的广义熵、直觉模糊集的模糊熵、Vague 集的模糊熵^[8-10],De-luca 等提出用总熵(total entropy,混合熵)来描述其不确定性^[11]。同样也有许多描述混合熵的函数^[12]。

误差熵不确定带模型的理论基础是信息熵及其最大熵原理。最大熵原理包括峰值功率受限条件下信源的最大熵和平均功率受限条件下信源的最大熵原理,均有特殊的限制条件。峰值功率受限条件下信源的最大熵是在 $\int_a^b p(x)dx = 1$ 下信源的最大相对熵。平均功率受限条件下信源的最大熵是在约束条件 $\int_a^b p(x)dx = 1$ 和

$$\sigma^2 = \int_a^b (x - m)^2 p(x)dx = K < \infty \quad (1)$$

下求的信源差熵的极大值^[13]。误差熵由观测误差的熵确定,即由残余信息熵 $H(X/X_n)$ 决定:

$$\Delta = \frac{1}{2} e^{H(X/X_n)} \quad (2)$$

式中, X_n 为随机变量; X_n 为观测矢量, 观测结果越精确, 误差熵越小。对于空间对象, Δ 为不确定范围的度量。

但是,模糊熵是事物固有模糊性的一种度量,对于一个模糊对象 A , $\sum_{i=1}^n \mu_A(x_i)$ 不一定等于 1, 即模糊熵和混合熵不存在上述限制条件;而误差熵是测量值在位置偏差的一种度量,通过熵半径来描述其范围。它们分别属于模糊空间和随机空间的两种测度,因此,对于模糊性和随机性共存的地理实体不适合用式(2)描述其位置不确定性。从数值的角度来看,由参数 (a, b, c) 定义三角模糊

Investigation of Uncertainty Integrative Description on Fuzzy Geographical Object

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Abstract: The random uncertainty and fuzziness uncertainty exist in spatial data at the same time. Ant that it is not suitable for using hybrid entropy to deal with the uncertainty of some geographical objects which contain random uncertainty and fuzziness uncertainty. The uncertainty of fuzzy geographical object was discussed by using type-2 fuzzy theory. The error model of membership of vague geographical object was built by using λ -cut of fuzzy set and error band of circle based on positional errors. The measure method of the error of membership was analyzed, Finally, the membership grade error cube was proposed to synthetically describe the uncertainty of fuzzy point.

Key words: fuzzy geometry; type-2 fuzzy sets; circle error band; membership grade error cube

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Link Dividing Method for Traffic Information Collecting Based on GPS Equipped Floating Car

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Abstract: According to the problem that different conditions of traffic flow of different turns around crossings are neglected and uniform traffic conditions on a link is supposed on link dividing methods for traffic information collecting based on GPS equipped floating car at present, which leads to traffic data with low quality and poor effect of the road traffic conditions identification system and vehicle dynamic navigation system. The directional link dividing method can be used to collect traffic data distinguishing different turns around crossings and sub-link dividing method can be used to collect traffic data distinguishing different places of a link are designed, which improves application effect of the road traffic conditions identification systems and vehicle dynamic navigation systems.

Key words: traffic information collection; floating car; GPS; link dividing

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