

安徽省数字城市地理空间框架建设探讨



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摘要:介绍了安徽省数字城市地理空间框架建设情况、建设内容和模式。结合工作实际情况,阐述了在自主平台研发、云计算技术、物联网技术、倾斜摄影测量技术、市县一体化建设等方面的探索与应用,分析了数字城市的建设过程,为领导机制和人才队伍建设两方面存在的问题提供了相关建议。

关键词:数字城市; 倾斜摄影测量技术; 市县一体化; 领导机制和人才队伍

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“数字城市地理空间框架建设”是“数字城市”建设的核心内容,其目的是为“数字城市”提供统一、权威的地理空间信息公共平台,为各部门分散的数据建立一个统一的标准,实现城市信息资源的整合和共享,避免重复建设^[1,2],同时有效地解决目前存在的差异问题,使城市信息化健康发展。

安徽省自2008年启动“数字城市地理空间框架建设”以来,认真按照国家测绘地理信息局最新的政策和技术指导,积极推动“数字城市”、“数字县域”项目在全省各市、县的开展,并不断拓展应用领域、创新应用思路、提高项目的建设标准、落实与天地图建设的结合、加强天地图市级节点建设,向智慧城市项目靠拢,增强示范应用建设。

1 建设内容和模式

安徽省数字城市地理空间框架建设按照“需求牵引、统一设计、多元投资、资源共享”的原则,由国家测绘地理信息局、安徽省国土资源厅和当地人民政府共同投资建设。项目通过整合已有的基础测绘资料,完成多个比例尺的DLG、DOM、DEM生产和更新工作,建设主城区真三维数据模型,采集地名地址数据,在此基础上进一步整合加工入库,建成城市基础地理信息数据库。然后经过数据提取、扩充、重组和脱密等工序处理^[3],建立权威的、通用的地理信息公共平台,向政府部门、企事业单位和社会公众提供丰富的地理信息服务,有力促进了城市信息资源共享和利用。每个城市建成至少5个典型应用示范系统,是在不同网络环境下,以数字城市地理信息公共平台为基础,不再重复建设基础地理信息数据,直接以平台提供的地理信息服务为底图,只需加载部门业务数据和开发专

业功能,最大化地实现数字城市地理空间框架对于基础地理信息数据“一次建设、多处使用”的目的。通过典型应用示范系统建设,对城市各行业、各部门加快本身信息化建设产生了很好的借鉴作用,对于城市地理空间框架最大化发挥作用具有重要价值,如图1。

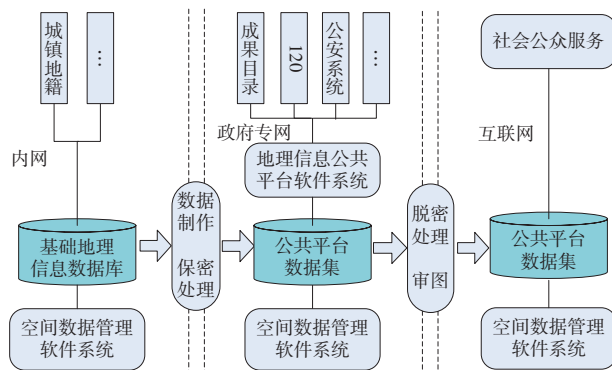


图1 安徽省数字城市地理空间框架建设内容与模式架构图

2 技术探索与特色

2.1 自主平台研发

安徽省基础测绘信息中心(以下简称“中心”)是在安徽省率先开展数字城市建设的单位,先后完成了“数字黄山”、“数字马鞍山”的建设任务,并分别获得国家测绘地理信息局和安徽省国土资源厅的表彰。在后续省内数字城市的建设任务中,中心担任技术支撑的角色。为了使数字城市建设在各地市能够快速推进,依据数字城市地理信息公共平台的建设标准与规范,中心结合自身技术积累,自主研发了一套平台搭建软件——城市空间信息共享平台软件。

地理信息公共平台是数字城市地理空间框架建设的核心内容之一,主要为用户提供了电子地图、资源中心、二次开发等服务模式,能够满足各部门各领域

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的跨平台、跨浏览器对地理信息的要求。平台紧扣数字城市地理信息公共平台建设相关规范,总结已建数字城市的成功经验,深入调研待建城市的需求,在此基础上研发完成了城市空间信息共享平台软件。承建单位利用该平台,通过可视化向导即可完成基础版、政务版和公众版数字城市地理信息公共平台的搭建,无需编写任何程序。

2.2 云计算技术

数字城市地理信息公共平台为全市各部门、企事业单位和社会公众提供地理信息服务,所以必须考虑服务的稳健性和抗并发能力。一旦资源不足、访问拥塞,各部门的专业系统都将无法调用地理信息,所有的应用系统都无法正常运转,后果严重。因此,在安徽省数字城市地理空间框架建设过程中,一直注重使用云计算技术,确保在访问量增大时,计算资源能够自动、快速、便捷地拓展,不影响应用部门的调用。

安徽省不同城市的云平台搭建方式不同。在马鞍山,其市政府已经搭建了政务云,因此,数字马鞍山地理信息公共平台只需要根据其应用的多少申请计算资源,再在其上部署服务软件,从而形成地理信息云平台。在滁州,由于没有政务云,所以将服务器托管在市政府信息中心,依托市政府完善的网络环境和软硬件安全设施搭建了私有云。通过不同方式云平台的建设,增强了数字城市地理信息公共平台的可靠性、稳定性和吸引力。

2.3 物联网技术

国家测绘地理信息局于 2012 年下发《关于开展智慧城市时空信息云平台建设试点工作的通知》,并先后出台了技术大纲和评价指标体系,安徽省在开展数字城市地理空间框架建设时,在技术的使用、应用示范的选择等方面,有意识向智慧应用倾斜,其中物联网也是智慧城市建设一个重要内容。

滁州市防汛排涝调度系统是物联网技术应用的一个最典型案例,系统实现了将视频监控、监测预警、气象信息等防汛排涝信息集成到数字滁州地理信息公共平台上,可提供适当的辅助信息,提高排水效率,加强防汛排涝指挥部的调度指挥能力。其中在线监控子系统通过视频、雨量计、液位仪等设备实现全市重点防汛排涝设施的实时监控。实现的主要功能包括视频接入、雨量在线监控、液位信息在线监控、泵站闸站监控、水位超限警报等,还具有排水建模分析功能。

2.4 倾斜摄影测量技术

倾斜摄影测量技术是测绘领域近些年发展起来的一项高新技术,它颠覆了以往正射影像只能从垂直角度拍摄的局限,通过在同一飞行平台上搭载多台传感

器,同时从一个垂直、4 个倾斜共 5 个不同的角度采集影像,将用户引入到符合人眼视觉的直观世界。在定位精度、真实性和建设效率上相对于传统人工建模有无可比拟的优势,一次航摄可以获取真三维建筑模型、数字正射影像图、数字高程模型等多种数据成果,非常适用于数字城市地理空间框架建设。

在数字六安地理空间框架建设中,就使用了倾斜航空摄影系统和机载激光扫描系统,对六安市约 63 km² 范围进行航空摄影,获取高精度的地面点云数据和倾斜影像数据,利用 LiDAR 点云分离获取建筑物模型,利用倾斜摄影数据生成可与 LiDAR 数据套合的空三加密成果,自动提取倾斜摄影测量传感器获取的建筑物顶面和侧面纹理,自动化建立真三维建筑物模型^[4]。

LiDAR 与倾斜摄影测量相结合的三维建模技术已广泛应用,但 LiDAR 数据获取成本高、密度大。随着计算机视觉和倾斜摄影测量技术不断发展,基于多基元、多视影像密集匹配技术日趋成熟,可以快速获取多视影像上的同名点坐标,进而得到地物的三维坐标^[5]。在数字黄山地理空间框架数据更新建设中,就采用了倾斜摄影测量自动建模技术,制作完成了屯溪区约 15 km² 城市高精度和高质量实景真三维模型数据,接下来黄山风景区三维场景制作也将使用倾斜三维自动建模系统来完成,目前正在获取约 160 km² 倾斜航空摄影数据,设计的影像平均地面分辨率为 0.08 m,航向重叠度为 81%,旁向重叠度为 80%。

2.5 市县一体化建设思路

随着数字城市在全国迅速展开,有条件的地区也开展了数字县域地理空间框架建设工作,我省明光市、芜湖县延续了数字城市地理空间框架的建设模式,但是,在建设过程中发现,相比地级市,县级存在长效机制落实不到位、更新不及时、应用推广深度与广度不够、自身技术力量薄弱、财政负担较重等问题,极大地阻碍了城市信息化建设的发展。黄山市是安徽省数字城市建设试点城市,第一轮 3 a 更新计划已经完成,起步早、基础好、经验丰富。为了能够有效克服县域城市地理信息资源共建共享存在的困难,综合考虑实际情况,在黄山市数字县域推进中,提出了市县一体化建设模式,即在数字黄山地理空间框架建设成果的基础上,充分发挥黄山市国土资源局的技术力量和软硬件优势,按照“依托市域、统一规划、统一建设、分步实施、量力而行”的原则,集全市之力整体推进、市县融合,由黄山市国土局负责统一建设、统一管理使用、统一维护更新,建成全市统一的、唯一的、权威的数字黄山县域地理空间框架,避免了项目建设

过程中的重复投入,节省人力、物力和财力,突破区县局技术力量薄弱和资金紧缺的限制,形成了高效率、集约化的数字黄山县域地理空间框架统一建设模式,见图2。

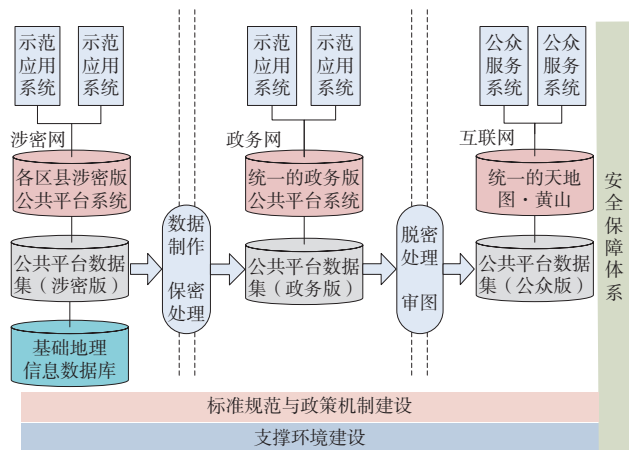


图2 数字黄山县域地理空间框架统一建设总体架构图

3 经验与反思

3.1 领导机制

安徽省数字城市地理空间框架建设项目在申请获批后,一般由安徽省国土资源厅和各地人民政府签订建设协议,落实各地国土资源局为牵头建设单位。在项目建设初期,一般会成立由各地政府分管领导为组长、各委办局主要负责人为成员的项目建设领导小组,负责协调各部门配合国土资源局共同推进。

随着项目建设逐步推进,由于人事变动,部分分管领导和主要负责人对数字城市地理空间框架建设的内涵认识不足,对项目进展和协调工作未给予足够重视,导致全部工作交由国土资源局负责推进。国土部门与其他应用部门是同级单位,加上国土部门自身事务繁多,在应用示范的推动过程中会遇到不少困难,从而造成项目建设进展缓慢,尤其是应用示范建设工作的迟滞会使得数字城市地理空间框架建设成果的现势性下降,吸引力降低,从而陷入更加难以推动应用的恶性循环。

经过总结反思,建议下一步建设与维护可考虑由各地测绘地理信息行政主管部门向各地方政府专门报告,陈述数字城市地理空间框架建设的意义、必要性以及国家测绘地理信息局的文件要求,建议对各地方政府发文作统一要求,并纳入政务考核指标。同时,开展数字城市地理空间框架建设培训班,邀请各地负责数字城市建设的主管领导参加,加强认识和理解,从而有效推动数字城市建设进程。

3.2 人才队伍建设

人才队伍建设是数字城市地理空间框架建设的重

要内容,是建设成果持续稳定运行和服务的关键。安徽省数字城市地理空间框架建设项目在设计时就提出成立专门机构负责城市地理空间框架的运行维护,并通过培养或引进遥感、地理信息系统、通讯、网络、计算机等方面的专业人才建立稳定的技术人员队伍,保证框架的持续更新和长期服务。然而,在当前背景下,成立专门机构和申请人员编制难以获得批准,安徽省已建成的城市大都采取招聘技术人员作为日常维护推广的主体力量。聘用人员流动性大,尤其政府部门招聘的人员,其工资待遇也难以完全市场化,不少城市都频繁出现刚培训完成的核心技术人员辞职的尴尬局面,这些都给数字城市地理空间框架的持续稳定运行造成了威胁。建议安徽省测绘地理信息行政主管部门出台相关政策,引导各地数字城市地理空间框架的运行、维护和更新走向市场,培育若干专注于数字城市建设的有资质、有实力的企业。同时,鼓励自身缺乏技术力量的各地国土资源局通过市场化购买服务的方式理顺机制,确保数字城市地理空间框架的持续更新运行维护,更好地服务地方经济发展。

4 结语

安徽省国土资源“十三五”规划提出加大“数字安徽”建设力度,推动智慧城市时空信息云平台建设。2016年底,安徽将全面完成16个地级市的“数字城市”和“天地图”建设。全力推动“数字县域”和智慧城市时空信息云平台建设,到“十三五”末完成30%“数字县域”建设,力争16个市全面启动智慧城市时空信息云平台建设,1~2个市完成试点建设。

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Research on Map Products System of Geographical Conditions Census and Monitoring

by DU Qingyun

Abstract With the completion of the First Geographical Conditions Census, a large volume of national geographical data (NGD) have been collected and there is a pressing need for map products to represent the total conditions of these data. However, because of the lack of map products system, units of surveying and mapping have no sufficient guidance for production of NGD and result in providing little necessary services for governors, enterprises and public. In this paper, a whole set of map products system for NGD was presented based on map production. Using this system, a series of detailed guidance can be obtained by related units to improve current map production efficiency on NGD. Moreover, a logical framework of online NGD maps production system was proposed to improve the efficiency of thematic maps production. This system was put into application and had achieved good results.

Key words NGD, map products system, thematic map production, online mapping system, assistant decision (Page:1)

Research on the Geographical Investigation Theory and Method Based on Geographical Knowledge Service

by LI Jing

Abstract In the framework of geographical sciences, this paper put forward the concepts of geographical investigation serving as a transitional applied service for geographical knowledge system, and clarified the contents and scopes of geographical investigation, as well as summarized the features of geographical investigation. On the basis of all above, the paper provided a system of techniques and methods for geographical investigation, and set up a platform for smart geographical investigation. At last, the paper elaborated the practice and application of techniques and methods for geographical investigation.

Key words geographical knowledge service, geographical investigation, geographical object, geographical event, geographical unit (Page:7)

Discussion on the Construction of Digital City Geospatial Framework in Anhui Province

by HOU Enbing

Abstract This paper introduced the schedule, contents and model of digital city geospatial framework construction in Anhui Province. And then, combined with practical work, the paper elaborated the application of this framework in the independent developing platform, cloud computing, internet of things, oblique aerial photogrammetry, city-county-integration and so on. At last, this paper analyzed the construction process of Digital City, and put forward some constructive proposal for the problems of construction on the aspect of leadership mechanism and building of talent team.

Key words Digital City, oblique aerial photogrammetry, city-county-integration, leadership mechanism and talent team (Page:13)

Research on the Methods for Geographical Conditions Standard Time-point Verification and Data Loading

by DA Xing

Abstract Combining with the first geographical conditions standard time-point verification in Wuhan, we elaborated the operation methods and implementation plan, and discussed data procession and quality control during the procedure of data updating, project acceptance and data loading. This study can provide technical support for normalized geographical conditions monitoring in the future.

Key words geographical conditions, standard time-point verification, project acceptance, data loading (Page:16)

Optimal Compression Method for LiDAR Point Cloud Data Based on Terrain Interpolation Algorithm

by WANG Haijun

Abstract LiDAR point cloud data can improve the accuracy of DEM, but it also can reduce the speed of data processing. So the appropriate compression of data is necessary. The best compression ratios for different terrain in a variety of interpolation algorithm and different scale have a maximum standard deviation, which can improve the data processing rate and it is very an efficient way for the processing of LiDAR cloud data. This paper introduced the best compression ratio based on ArcGIS software and the compression method for difference of point slope based on python.

Key words the best compression ratio, terrain interpolation, standard deviation, the difference of slope, slope of the normal vector (Page:19)

Research on Rendering of Massive Point Cloud Based on Multi-resolution LOD

by YANG Zhenfa

Abstract Smooth display of massive point cloud is the basis of point cloud data processing and analysis. This paper used octree data structure to block the massive point cloud. And then, in order to construct multi-resolution LOD

data structure, the paper randomly sampled the octree leaf nodes of point cloud layer-by-layer, and kept the data in external storage. The paper designed a new method that in-core and out-of-core exchange strategy of multi-resolution point cloud based on the viewpoint, which could realize the smooth display of the massive point cloud. In the end, the experiments were carried out for a set of massive point cloud data, and analyzed the different octree partition of depth impacts on octree partition and generation of multi-resolution data and rendering. The result concludes that this approach in this paper is able to smoothly render hundreds of millions of points on the regular computer.

Key words octree, multi-resolution LOD, massive point cloud, in-core and out-of-core exchange, point cloud rendering (Page:22)

Auto-modeling in 3D GIS Based on Rule

by XIE Xiaokui

Abstract In this paper, ESRI CityEngine software was used to automatically create 3D GIS model. ArcGIS was used to generate 2D vector data and 3D information was stored in the attribute database. And then, we used this method to create the 3D model of Hunan Agricultural University. The result shows that rule-based modeling can automatically generate 3D model which has the advantage of speed and efficiency. Therefore, rule-based modeling is especially suitable for massive 3D modeling required for Smart City construction under the background of big data. In addition, this method can meet the requirements of candidate plan comparing with different design parameters, and provide support for landscape planning and geo-design.

Key words GIS, 3D modeling, CityEngine (Page:26)

Application of GF-1 and GF-2 Satellite in Idle Land Monitoring

by YIN Feng

Abstract Taking Wuhan City as study area, according to the technical standards and requirements of idle land clearing, we used the data of GF-1 and GF-2 to produce digital orthophoto maps and extracted idle land information in this paper. Furthermore, on the basis of qualitative and quantitative analysis, the applicability of using GF-1 and GF-2 to monitor idle land was tested. The results show that the high resolution remote sensing data like the data of GF-1 and GF-2 are rich in spectrum information, and have distinct interpretation symbols, so that the important information of cities' idle land can be reflected well. Therefore, the high resolution remote sensing data can meet the needs of idle land business.

Key words GF-1, GF-2, idle land, applicability, application and promotion (Page:29)

Automatic Detection of Change Areas Based on the Time-point Approval of Geographical Conditions Census

by WANG Ligang

Abstract This paper analyzed the detection methods of geographical conditions census change area based on the status, briefly introduced the work contents of geographical conditions census time-point approval, and introduced the monitoring process of change area based on images in detail. Due to the constraints of the data source, the time-point approval didn't have the identification conditions of change area using by remote sensing interpretation software directly. Based on the result data of previous stage, combined with time-point approval images, the paper put forward a method for detecting change area based on image changes.

Key words detection of change area, land cover classification, supervised classification (Page:33)

Land Potential Evaluation System of the Reconstruction of Old Factory Buildings, Old Villages and Old Towns Based on Component GIS

by WANG Gang

Abstract This paper combined 26 indexes, three standard models and five databases into a land potential evaluation system. The system has strong ability in reconstruction of "Three Old", and also can meet the urgent requirements of lacking land potential evaluation system. The experiments show that the system can build up dynamic link library of evaluation model, and calculate 7 potential evaluation models. The system can help to improve the scientificity and the objectivity for evaluation model, and provide some assistant decisions for technical personnel and decision makers.

Key words component GIS, reconstruction of "Three Old", potential evaluation, evaluation model (Page:35)

Research on County Public Facilities Reachability Based on GIS Network Analysis

by YAN Fengying

Abstract We took Changxing County medical facilities as object to study public services reachability based on GIS network analysis in this paper. Firstly, according to research data, we established the GIS database of Changxing