

# 广播与电视技术



Radio & TV Broadcast Engineering

全国百种重点期刊 专业核心科技期刊

第48卷 第5期 VOL.48 NO.5

## 融合创新 智慧广电

推动行业高质量创新性发展



广告

ISSN 1002-4522



9 771002 452210

国家广播电视总局 主管  
国家广播电视总局广播电视规划院 主办



主管 国家广播电视总局  
主办 国家广播电视总局广播电视规划院

邮发代号:82-464

编辑出版:《广播与电视技术》编辑部

通讯地址:北京2116信箱(100866)

电话:010-86093619(作者服务) 010-86092040(读者服务)

投稿网址:tougao.lieku.cn

主编:何剑辉

国内总发行:北京报刊发行局

副主编:卢群

订购处:全国各地邮局

运营总代理:北京中广信通文化传媒有限公司

编辑:房磊 李丹

市场专员:王翠霞(13651307963) 邮箱:wangcuixia@tvoao.com

国外总发行:中国出版对外贸易总公司(北京728信箱100011)

发行:胡南

广告经营许可证:京西工商广字0029号

国内定价:20.00元/本 国外定价:20美元/本

美编:张云峰

刊号:ISSN 1002-4522  
CN11-1659/TN

# 目次

全国百种重点期刊 专业核心科技期刊  
投稿平台 [tougao.lieku.cn](http://tougao.lieku.cn)

中国邮政  
微信订阅



2021年 | 第48卷 | 第5期

## 热点·论点

### 智慧广电示范案例研究

- 13 加强组织管理 推动智慧广电建设提质升级 张苗苗,孙可,张庆男
- 16 技术创新促进内容创新,融合生产推动流程再造 孙琳,肖婧,孙可,邓向冬,牛睿
- 23 5G网络通渠道,传输覆盖强发展 欧阳峰,李楠,李婷婷,杨琪,梁相君
- 28 科技赋能广播电视运行监管 拜路,李纪涛
- 33 加快培育智慧广电生态,推动服务方式转型升级 陈德林,何剑辉,张智军,覃千洛

## 融合·创新

- 41 数字音频水印技术在跨屏互动中的应用 王旖旎,邸娜

## 内容制播

- 47 5G+4K+VR高新视频生产的技术实现 郑磊
- 51 SDI+IP混联互备框架下全频道全高清电视播总控系统的设计与实现 江立宇,郑沈海
- 56 融媒体高清新闻演播室系统设计与实现 方莉萍
- 61 广播电视台移动端运营监管平台设计 刘汉武
- 64 基于广播电视播出节目单的自动技审辅助系统设计与实现 唐思腾,毛品莉,于含迪,全伟,姚琥,吴鹏
- 69 县市级大数据网络融媒体平台应用研究 李晓磊,赵宇

## 有线网络

- 73 基于广电网络的多厂商PON设备综合网管系统设计 邱丰
- 77 广电城域MSTP网骨干环的优化和应用 蒋超



主管: 国家广播电视总局

主办: 国家广播电视总局广播电视规划院

《广播与电视技术》是由国家广播电视总局主管,国家广播电视总局广播电视规划院主办,《广播与电视技术》编辑部编辑出版的国家级技术期刊,是发布广播电视科技政策,反映事业建设成就,介绍高新技术,交流工作经验,传播各种信息的重要媒体。本刊主要面向各级广播电视行业主管部门、各级广播电台、电视台、网络公司、发射台、微波站、卫星站、节目制作单位及电教系统,同时对企业、工矿、学校、部队等具有公共广播电视设施的管理人员、技术人员也有参考价值。

为繁荣学术交流,本刊已加入《中国学术期刊网络出版总库》、“万方数据”和“维普中文科技期刊数据库”,有权选取部分论文在本刊关联平台(如广电猎酷网 www.lieku.cn、“广电猎酷”微信公众号等)发布,作者著作权使用费已随论文稿酬一次性给付。本刊充分尊重作者的原创成果并合理保护作者享有的权利,如作者不同意本刊之外其他形式的发布,请在来稿中声明,本刊将作适当处理。本刊及主办单位对本刊已发布作品的内容和观点不持有任何立场、不做任何承诺或保证、不承担任何责任。

# 目次

全国百种重点期刊 专业核心科技期刊  
投稿平台 [tougao.lieku.cn](http://tougao.lieku.cn)



中国邮政  
微信订阅

2021年 | 第48卷 | 第5期

- 82 IP播出架构下的有线前端传输平台建设 陈军,张辉
- 87 有线双向业务质量拨测解决方案研究与实践 曹卫明,韩晓非,杨洋
- 92 基于广电综合业务网的公安智慧交通系统建设 杨文涛

## 无线覆盖

- 96 DTMB节目传送系统设计与改造实践 杨志平
- 100 广播电视微波传输IP化改造方案与实践 孙照学,周景春
- 107 微波传输中心机房UPS电源割接方案探析 陈玮
- 111 智能一体化电源在高山转播台的应用 黄克元,肖辉,兰祥君

## 卫星传输

- 115 卫星接收系统抗5G干扰改造效果的评估方法研究 高洋,代明,杨帆,张勇,李国平
- 120 基于Python的地球站上行设备网管设计和实现 黄展刚,李一帆

## 安全播出与监测监管

- 125 地市级广播电视广告监管平台的设计和实现 陈顺峰,许扬
- 129 发射安播业务智慧化的具象思考和技术实践 黄培建
- 134 高山发射台IP架构信号系统设计 唐东,庄大立,周义

## 论述·点评

- 139 广电网络数据中心发展需求和建设路径探索 陆月兵,叶志强,刘晨鸣
- 143 我国运营商5G承载网现状分析 李婷婷,朱里越,汤新坤

广告索引 P150



主管: 国家广播电视总局  
主办: 国家广播电视总局广播电视规划院

邮发代号: 82-464

全国百种重点期刊 专业核心科技期刊

导 读

tougao.lieku.cn

中国邮政  
微信订阅



2021年 | 第48卷 | 第5期

### [41] 数字音频水印技术在跨屏互动中的应用

当前,广播电视技术与新一代信息技术加速融合,使广电发展面临新机遇与新挑战,节目制作、网络传输、终端服务都向智能化及跨屏互动演进。本文基于已有的数字音频水印技术,为电视台搭建了一个可兼容多种视频格式和传输方式的通用示范平台,可用于收视率调查、用户互动、台内节目的监控监管等多个方面,不失为电视融合发展中跨屏互动应用的一种有益探索。

### [47] 5G+4K+VR高新视频生产的技术实现

5G高新视频作为5G垂直应用的重要领域,对于推动5G商用发展有着举足轻重的作用和意义。本文通过对浙江广电集团好易购电视购物频道相关5G应用案例介绍及实践经验总结,可咨广播电视5G+4K+VR高新视频融合发展时参考借鉴。

### [73] 基于广电网络的多厂商PON设备综合网管系统设计

综合网络管理系统是广电网络建设和运营中比较重要的一个系统,但如何对广电网管系统实施有效的统一管理却一直困扰着广电网络运营商。本文从硬件、软件、接口等方面,较为详尽地介绍了基于广电网络的多厂商PON设备综合网管系统的设计,可供业界同行参考。

### [100] 广播电视微波传输IP化改造方案与实践

IP微波具有兼容性强、投资少、建设周期短的特点,可以提升微波通道的利用效率,是广播电视微波传输发展的方向。海南广播电视总台结合当地实际情况,综合考虑链路现状、业务需求、技术发展、资金投入等多方面因素,充分利用现有链路资源,以较少投入完成了数字微波从SDH体系向IP化的平滑转换,实现了IP微波链路干线传输总速率超过1Gbps的目标。其作法和经验值得业界同行借鉴。

### [115] 卫星接收系统抗5G干扰改造效果的评估方法研究

目前,受5G信号干扰的广播电视卫星接收台站多已依据《C频段广播电视卫星接收站与5G基站干扰协调实施办法(试行)》进行了系统改造,应及时对改造效果进行全方位评估,判断是否已有效解决了5G信号干扰问题。本文提出一种系统评估卫星接收系统抗5G干扰改造效果的方法,为今后各广播卫星接收台站进行抗5G干扰改造、评估测试提供了借鉴和参考,对确保广播电视安全播出具有十分重大的意义。



**Competent Authority:**  
**National Radio and Television Administration**  
**Sponsor: Academy of Broadcasting Planning, NRTA**

**Publisher:** Editorial Department of RTBE

**Chief Editor:** He Jianhui

**Deputy Chief Editors:** Lu Qun

**Editors:** Fang Lei Li Dan

**Circulation Coordinator:** Hu Nan

**Art Editor:** Zhang Yunfeng

**Tel:** (86-10) 86093619 (Author service) (86-10) 86092040 (Reader service)

**Web Address:** tougao.lieku.cn

**Address:** P.O.Box 2116, Beijing, P.R.China

**Post Code:** 100866

**Postal Distributing:** Code 82-464

**General agent of operation:** Beijing China Broadcasting Media Co., Ltd.

**Marketing:** Wangcuixia(13651307963) E-mail:wangcuixia@tvoao.com

**Journal Number:** ISSN 1002-4522 / CN11-1659/TN

**Prices:** RMB 20 for one copy (in China)

USD 20 for one copy (outside China)

# Contents

**One of Hundred National Key Periodicals**  
**A Core Professional Sci-Tech Periodical**  
**tougao.lieku.cn**

May 2021 No.5

## Smart Radio and TV Case Study

- 13 Enhancing Organization and Management , Upgrade the Construction of Intelligent Radio and Television *By Zhang Miaomiao, Sun Ke, Zhang Qingnan*
- 16 Technological Innovation Promotes Content Innovation, and Production Convergence Promotes Process Reengineering *By Sun Lin, Xiao Jing, Sun Ke, Deng Xiangdong, Niu Rui*
- 23 5G Builds New Route, and Transmission Network Assists New Development *By Ouyang Feng, Li Nan, Li Tingting, Yang Qi, Liang Xiangjun*
- 28 Advanced Technology Empowers Radio and Television Operation Supervision *By Bai Lu, Li Jitao*
- 33 Accelerate Eco-development of Intelligent Radio and Television and Push Service Mode Changing and Upgrading *By Chen Delin, He Jianhui, Zhang Zhijun, Qin Qianluo*

## Convergence & Innovation

- 41 Application of Digital Audio Watermarking Technology in Cross-screen Interaction *By Wang Yini, Di Na*

## Content Production & Broadcasting

- 47 Technical Realization of 5G+4K+VR Advanced-format and New-concept Video Production *By Zheng Lei*
- 51 Design and Implementation of Full channels and Full HD TV Broadcast Master Control System Based on SDI + IP Mixed connection and Mutual Backup Framework *By Jiang Liyu, Zheng Shenhai*
- 56 Design and Implementation of Converged Media HD News Studio System *By Fang Liping*
- 61 Design of Operation and Supervision Platform for Mobile Terminal Business of Radio and TV *By Liu Hanwu*
- 64 Design and Implementation of Automatic Technical Examination Auxiliary System Based on Broadcast Program List *By Tang Siteng, Mao Pinli, Yu Handi, Quan Wei, Yao Hu, Wu Peng*
- 69 Research on the Application of Big Data Network Converged Media Platform at County and City Level *By Li Xiaolei, Zhao Yu*

## CATV

- 73 Design of Integrated Network Management System for Multi-vendor PON Equipment Based on Radio and Television Network *By Qiu Feng*
- 77 Optimization and Application of Backbone Ring of Broadcast Metropolitan Area MSTP Network *By Jiang Chao*
- 82 Construction of Cable Front-end Transmission Platform Based on IP Broadcasting Architecture *By Chen Jun, Zhang Hui*
- 87 Research and Practice on the Solution of Cable Two-way Service Quality Dial Test *By Cao Weiming, Han Xiaofei, Yang Yang*
- 92 Construction of Public Security Intelligent Traffic System Based on Radio and Television Integrated Business Network *By Yang Wentao*

## Wireless Coverage

- 96 Design and Transformation Practice of DTMB Program Transmission System *By Yang Zhiping*
- 100 Scheme and Practice of IP Transformation for Radio and TV Microwave Transmission *By Sun Zhaoxue, Zhou Jingchun*
- 107 Analysis of UPS Power Cut-off Scheme in Microwave Transmission Center Room *By Chen Wei*
- 111 Application of Intelligent Integrated Power Supply in Alpine Relay Station *By Huang Keyuan, Xiao Hui, Lan Xiangjun*

## Satellite Transmission

- 115 Research on Evaluate Method of Anti-5G Interference Transformation Effect for Satellite Receiving System *By Gao Yang, Dai Ming, Yang Fan, Zhang Yong, Li Guoping*
- 120 Design and Implementation of Network Management of Earth Station Uplink Equipment Based on Python *By Huang Zhangang, Li Yifan*

## Safety Broadcasting & Monitoring

- 125 Design and Implementation of Advertising Supervision Platform in Municipal Radio and Television *By Chen Shunfeng, Xu Yang*
- 129 Concrete Thoughts and Technical Practices on Intelligentization of Safe Broadcasting Service of Transmitting *By Huang Peijian*
- 134 Design of Signal System Based on IP Architecture for Alpine Transmitting Station *By Tang Dong, Zhuang Dali, Zhou Yi*

## Elaboration & Commentary

- 139 Exploration on Development Demand and Construction Path of Broadcasting Network Data Center *By Lu Yuebing, Ye Zhiqiang, Liu Chenming*
- 143 Analysis of Status Quo of 5G Bearer Networks of China's Operators *By Li Tingting, Zhu Liyue, Tang Xinkun*



**Competent Authority:**  
**National Radio and Television Administration**  
**Sponsor: Academy of Broadcasting Planning, NRTA**

Radio & TV Broadcast Engineering (RTBE) is a state-class technical journal, approved by the General Administration of Press and Publication, PR of China, authorized by the National Radio and Television Administration (NRTA), PR of China, sponsored by Academy of Broadcasting Planning (ABP), NRTA, and published by Editorial Department of RTBE. RTBE is an important medium, that publishes scientific and technological policies in broadcasting, reports achievements in building broadcasting cause, introduces high and new technologies, exchanges work experience and spreads various information. RTBE is mainly geared to the needs of departments responsible for the work of radio & TV industry at all levels, radio & TV stations at all levels, network companies, transmitting stations, microwave stations, satellite stations, program production units and electrified education systems, as well as is of reference value to managerial and technical personnel for public radio & TV facilities in industrial and mining enterprises, educational institutions, troops and so on.

# Index

**One of Hundred National Key Periodicals**  
**A Core Professional Sci-Tech Periodical**  
[tougao.lieku.cn](http://tougao.lieku.cn)

May 2021 No.5

## [ 41 ] **Application of Digital Audio Watermarking Technology in Cross-screen Interaction**

At present, accelerating integration of radio and television technology and new generation of information technology has caused the development of radio and television to face new opportunities and new challenges. Program production, network transmission, and terminal services are all evolving toward intelligence and cross-screen interaction. Based on the existing digital audio watermarking technology, this paper builds a universal demonstration platform for TV stations that is compatible with multiple video formats and transmission methods, which can be used for ratings surveys, user interaction, monitoring and supervision of programs in the station, etc. It is a beneficial exploration of cross-screen interactive applications in the development of TV convergence.

## [ 47 ] **Technical Realization of 5G+4K+VR Advanced-format and New-concept Video Production**

As an important field of 5G vertical applications, 5G advanced-format and new-concept video plays a pivotal role and significance in promoting commercial development of 5G. This paper introduces relevant 5G application cases and summarizes practical experience of Best1 TV Shopping Channel of Zhejiang Radio and Television Group, which can be used for reference in convergence development of radio and television 5G + 4K + VR advanced-format and new-concept video.

## [ 73 ] **Design of Integrated Network Management System for Multi-vendor PON Equipment Based on Radio and Television Network**

Integrated network management system is a relatively important system in construction and operation of radio and television network, but how to implement effective unified management of radio and television network management system has always troubled radio and television network operators. From the aspects of hardware, software, interface, etc., this paper introduces in detail the design of integrated network management system of multi-vendor PON equipment based on radio and television network, which can be referred by peers in the industry.

## [ 111 ] **Scheme and Practice of IP Transformation for Radio and TV Microwave Transmission**

IP microwave has the characteristics of strong compatibility, low investment, and short construction period, which can improve utilization efficiency of microwave channels and is development direction of radio and television microwave transmission. Hainan Broadcasting Group combines with local actual conditions, comprehensively considers link status, business requirements, technological development, capital investment and other factors, makes full use of existing link resources, completes smooth conversion of digital microwave from SDH system to IP with less investment, and achieves the goal that total transmission rate of IP microwave link trunk line exceeds 1Gbps. Its practices and experience are worth learning from industry peers.

## [ 115 ] **Research on Evaluate Method of Anti-5G Interference Transformation Effect for Satellite Receiving System**

At present, most of radio and TV satellite receiving stations that are interfered by 5G signals have carried out system transformation in accordance with "Implementation Measures for Coordination of Interference between C-band Radio and TV Satellite Receiving Stations and 5G Base Stations (Trial)". Transformation effect should be comprehensively evaluated in time to determine whether 5G signal interference problem has been effectively solved. This paper proposes a method for systematically evaluating the effect of anti-5G interference transformation of satellite receiving system, which provides a reference for anti-5G interference transformation and evaluation test of broadcasting satellite receiving station in the future, and is of great significance to ensure safe broadcast of radio and television.