TOSHIBA REVIEW

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Special Reports

Weather Disaster Reduction and Mitigation Solutions Supporting People's Lives

Observation and Prediction of Heavy Rainfall and Social Roles of Such Activities
NAKAKITA Eiichi

Toshiba Weather Disaster Reduction and Mitigation Solutions Contributing to Realization of Safe and Secure Society
YAGINUMA Ryoichi / ANDO Yasuhiro / KAWANO Shuichi
With the recent increase in large-scale weather disasters, damage caused by such disasters is becoming increasingly severe year by year. Toshiba has been designing and manufacturing weather radars to observe these hazardous weather phenomena for more than 60 years. Our development of new types of weather radars such as world's first commercial solid-state weather radar applying high-power microwave semiconductor technologies and the provision of various disaster reduction solutions based on second-order analyses using precise weather data are significantly contributing to the field of meteorological observation in Japan, which is considered to be an advanced country in terms of disaster reduction.
With regard to disaster reduction countermeasures in other countries, however, there are many countries and regions that have been unable to fully introduce observation instruments. In order to reduce weather disasters worldwide, we have been promoting not only the international standardization of specifications for weather radars but also the optimization of observation data for weather disaster reduction and mitigation solutions, and are making efforts to construct the optimal system for each region in order to enhance the safety and security of the local residents' lives.

Technologies for Weather Radars to Achieve Highly Precise Wide-Area Observation of Precipitation
WADA Masakazu / MUTO Ryuichi
The recent increase in disasters caused by anomalous weather events including localized torrential rainfall and wind gusts has become a social issue. Demand has therefore been increasing for the development of weather observation technologies to facilitate the provision of disaster reduction information.
Toshiba has been developing cutting-edge weather radars offering superior performance in observing rainfall conditions over a wide area utilizing its industry-leading radar technologies; namely, solid-state transmitter technologies for multiparameter (MP) observations and phased-array radar technologies for three-dimensional weather observations. We have been making continuous efforts to realize the safe and secure operation of social infrastructure systems through the introduction of such evolving technologies for weather radars.

X-Band 130 W-Class GaN HEMT for SSPAs in Radar Systems
YAMAMURA Takuji / KURODA Kenta / SAKURAI Hiroyuki
Toshiba has developed an X-band (8-12 GHz) 130 W-class gallium nitride (GaN) high electron mobility transistor (HEMT) device for solid-state power amplifiers (SSPAs) used in weather and marine radar systems.
This GaN HEMT device achieves a saturated power output of 144 W and a power-added efficiency (PAE) of 52% under pulsed operation at 9.0 GHz (duty ratio: 10%; pulse width: 100 μs) through improvement of the chip structure of existing GaN HEMT devices and enhancement of performance by applying a matching circuit to control harmonic components based on active load-pull measurement. SSPAs employing the newly developed GaN HEMT device are expected to contribute to the accelerated dissemination of X-band radar systems offering high-precision observation capabilities together with compact dimensions, light weight, and long operating life.

Phased-Array Weather Radar to Sense Signs of Extreme Weather Events Including Torrential Rainfall
MIZUTANI Fumihiko / GOTOH Hideto
The major cause of extreme weather events, such as torrential rainfall, thunderstorms, sudden gusts of wind, hailstorms, and so on, is the rapid growth of cumulonimbus clouds within a short time span of about 10 to 30 minutes. To accurately grasp the growth of cumulonimbus clouds, a weather radar system must be able to perform both three-dimensional (3D) observations within a time frame of one minute and multiparameter (MP) observations using dual polarization.
Toshiba has already developed a phased-array weather radar for 3D weather observations, which can observe weather within a radius of 60 km and at altitudes up to 16 km with only one horizontal rotation of the antenna, while reducing the time required for observation to only 10 to 30 seconds. We are now developing technologies for key components to realize a dual-polarization phased-array weather radar, including a dual-polarized phased-array antenna as well as transmitter and receiver modules.

Sensor Fusion System for Comprehensive Observation of Weather Phenomena
YUGE Nobuko / KIDA Satoshi
As a result of the attention being focused on reducing the damage caused by natural disasters and improving the operational efficiency of natural-energy electricity generation systems, there is a growing need for advanced observation technologies to provide a broader understanding of weather phenomena.
Toshiba has been promoting the development of sensor fusion systems not only for the observation of meteorological parameters by integrating various meteorological sensors, but also for the comprehensive management and utilization of such meteorological data. As part of these efforts, we have developed a phased-array weather radar and Doppler lidar fusion system that makes it possible to observe the three-dimensional distribution of rainfall and wind velocity as well as a wide range of other meteorological elements, and delivered the system to the National Institute of Information and Communications Technology (NICT). This system is equipped with a large monitor display incorporating various functions including a quick-look function to access observation data using a Web browser and a function to simultaneously display combined data by overlaying multiple sensor data, to facilitate the effective analysis of observation data. The newly developed system is expected to contribute to the understanding and prediction of extreme weather phenomena such as localized torrential rainfall.

Sewerage Operation Support System Utilizing Rainfall Radars
TAKAHASHI Kiyohiro / UMEDA Kenji / WADA Masakazu
With the frequent occurrence of flood damage in recent years caused by localized torrential downpours, countermeasures against weather risks have become increasingly important. In order to protect urban areas from flood damage by rapidly responding to localized torrential rainfall, it is essential for operators of sewerage facilities to grasp accurate information in accordance with the rainfall conditions.
Toshiba has been developing and supplying various sewerage operation support systems to municipalities by integrating its proprietary technologies for rainfall radars, prediction technologies, and information and communication technologies (ICTs) for data processing and distribution. These sewerage operation support systems facilitate the effective operation of sewerage facilities and contribute to the reduction of flood damage by providing prompt and accurate information related to localized torrential rainfall.

Feature Articles

Automated Quantification Technology for Cerebrospinal Fluid Dynamics Based on Magnetic Resonance Image Analysis
SHIODERA Taichiro / YUI Masao / YAMADA Shinya
Time-spatial labeling inversion pulse (Time-SLIP) technology, which is a non-contrast-enhanced magnetic resonance imaging (MRI) technology for the visualization of blood flow and cerebrospinal fluid (CSF) dynamics, is used for diagnosis of neurological diseases related to CSF including idiopathic normal-pressure hydrocephalus (iNPH), one of the causes of dementia. However, physicians must subjectively evaluate the velocity of CSF dynamics through observation of Time-SLIP images because no quantification technology exists that can express the values numerically.
To address this issue, Toshiba, in cooperation with Toshiba Medical Systems Corporation and Toshiba Rinkan Hospital, has developed an automated quantification technology for CSF dynamics utilizing MR image analysis. We have confirmed the effectiveness of this technology through verification tests using a water phantom and quantification experiments using images of healthy volunteers.

Receiving Subarray Unit with Superconducting Filters to Improve Sensitivity of Phased-Array Antennas
SHIOKAWA Noritsugu / KAWAGUCHI Tamio / SHINONAGA Mitsuyoshi
Microwave phased-array antennas, which are used in various fields including wireless communication and radar systems, have been required to provide higher sensitivity in recent years in order to enhance communication capabilities, reduce the power consumption of transmitters, and extend the detection range of radar systems.
To fulfill these requirements, Toshiba has developed a receiver module capable of detecting a weak signal amidst thermal noise by means of superconducting filters and low-noise amplifiers operated at a cryogenic temperature of around -200°C, as well as a contactless microwave interface with both thermal insulation and low-loss microwave propagation properties in order to maintain the cryogenic temperature. Experiments on a prototype receiving subarray unit have confirmed that it is possible to realize a phased-array antenna with higher sensitivity using this technology.

Software Platform to Accelerate Installation of Image Recognition Technologies in Products
MIYAKE Tatsuya / KAWAKAMI Takashi / HASHIMOTO Keisuke
Although image recognition technologies have recently been applied to a broad range of products, the time required for product application is a significant issue due to the shortage of developers with sophisticated expertise in this field.
As a solution to this issue, Toshiba has developed a software platform with reusable component libraries including its proprietary advanced image recognition algorithms. This software platform provides functions that make it possible to easily design software by selecting and combining components, as well as functions to automatically determine the optimal combination of algorithms corresponding to various recognition objects, allowing even inexperienced developers to develop image recognition applications efficiently.

Material with Low Friction and High Wear Resistance for Water-Lubricated Bearings
THAN TRONG Long / KOJIMA Takanobu / OGUMA Tadashi
To prevent environmental pollution from leakage into rivers of lubricant oils in the oil-lubricated bearings of hydroelectric power systems, demand has recently arisen for water-lubricated bearings.
Toshiba has been making efforts to develop an appropriate material for water-lubricated bearings with a low friction coefficient and high wear resistance. We have already developed a bearing material using polytetrafluoroethylene (PTFE) as a base material and applied it to water-lubricated bearings in a number of hydroelectric power stations. These water-lubricated bearings have demonstrated good bearing characteristics and high reliability and have been contributing to smooth operations. We have now developed an advanced high-performance material for water-lubricated bearings that can be applied to high-pressure, high-temperature conditions and abrasive environments caused by sand grains in river water.

THNSNJ480PCS3 480 Gbyte Recording Capacity 2.5-inch SSD Equipped with SATA Interface for Enterprise Use
SAKAI Yoshimichi / OHYAMA Ryuichiro / MATSUDA Yoshiharu
The increasing volumes of data accompanying the rapid expansion of cloud services and big data in recent years have given rise to the need for data center systems with higher speed and larger capacity in order to efficiently provide network services. Solid-state drives (SSDs) have come into widespread use as storage devices for servers and storage systems in data center systems due to their superior memory access performance compared with hard disk drives (HDDs).
In response to these circumstances, Toshiba has developed the THNSNJ480PCS3, a 2.5-inch enterprise SSD with a capacity of 480 Gbytes equipped with a Serial Advanced Technology Attachment (SATA) to realize easier handling, as an addition to its lineup of high-end enterprise SSDs incorporating Serial Attached SCSI (Small Computer System Interface) (SAS) technology.

"MediaGuide Replay" Recording Function for Cloud TVs Based on Personalized Time-Shift Machine for European Market
TSUJI Masashi
Toshiba released the "MediaGuide Replay" recording function for cloud TVs in the European market in the spring of 2014. We had already developed the "time-shift machine," a recording function for the Japanese market, which allows users to watch programs of interest at any time by means of multichannel recording. However, it was difficult to apply this recording function to cloud TVs for the European market because of the large number of channels in Europe. MediaGuide Replay makes it possible to provide an automatic recording function using cloud services based on personalized program preference information and a series program recording function while also taking effective time-shift viewing of programs into consideration.
In automatic recording, users' favorite programs can be automatically recorded by a personalized recommendation technology acquired through the development of the time-shift machine. In series program recording, users can easily track and record all programs of interest in a series, even in cases where a large number of rebroadcast programs exist. Furthermore, the graphical user interface (GUI) of MediaGuide Replay displays both the programs scheduled for recording by timer and already recorded programs on one screen, to provide users with a superior time-shift viewing experience.

Frontiers of Research & Development