Development of Terrestrial Digital TV Broadcast Receiver

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Abstract

Japan’s digital terrestrial TV broadcasting began in December 2003 in Tokyo, Osaka and Nagoya. At the end of 2006 the service area will be expanded, enabling 50% of the nation’s households to view the broadcasts and generating a growing need for digital TV in vehicles also. Fujitsu Ten embarked on development in 2000; by December 2005 we had created commercial products, and these were adopted as factory options for the Toyota Motor Corporation in January 2006. Receiving Hi-Vision transmissions stably in under mobile conditions requires a lot of technology. We devoted particular effort to technology for stable reception in the face of Doppler shifts during high speed travel, and developed custom LSI and an antenna system. Digital broadcast come with data as well as pictures and audio. We developed a BML browser to display the data, and graphics LSI / software to enable its manipulation via touch-keys. The in-vehicle digital TV developed provides stable pictures and audio like those of home systems, and also provides broadcast data.
Introduction

Overview and features of the Fujitsu Ten digital TV products

Good reception characteristics during high speed driving conditions
All control performable via touch panel

Technology that lowers the data rate by compressing the audio and visual signals (data source encoding technology);

Technology that turns multiple encoded data sources into a single datastream, thereby enabling interlinkage of data sources;

Error correction technology that can correct errors occurring along the transmission paths by using the pre-assigned codes; and

Modulation technology and transmission path encoding technology for superimposing data on radio waves.

4.1 Improvement of mobile reception performance

Issues in the development of in-vehicle terrestrial digital TV

Overview of terrestrial digital TV broadcasting
Development of Terrestrial Digital TV Broadcast Receiver

4.2 Realization of control displays suited to vehicles

4 Technology to improve mobile reception performance

5.1 Reception performance enhancing algorithm

- Technology to improve mobile reception performance

(1) Frequency division/multiplexing diversity;

(2) High-precision interpolation for transmission path distortion by means of pilot signal; and

(3) Directional antenna switching reception

(1) Frequency division/multiplexing diversity

...
(3) Directional antenna switching reception

3.3 Directional antenna switching reception

A directional antenna is used to improve the reception of FM radio signals. A practical method of improving the quality of FM radio reception is to utilize a directional antenna that has higher selectivity than a monopole antenna. Figure 3.3 shows two methods of improving FM radio reception: one is to use a monopole antenna, and the other is to use a directional antenna such as a parabolic antenna or a Yagi antenna.

Table 3.3 shows the improvement of FM radio reception using a directional antenna. The results show that the use of a directional antenna can improve the reception of FM radio signals. In the case of a monopole antenna, the reception is not as good as when using a directional antenna. Therefore, the use of a directional antenna is recommended for improving FM radio reception.

<table>
<thead>
<tr>
<th>Monopole Antenna</th>
<th>Directional Antenna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>Improvement</td>
</tr>
<tr>
<td>50%</td>
<td>70%</td>
</tr>
<tr>
<td>60%</td>
<td>80%</td>
</tr>
<tr>
<td>70%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Figures 3.3a and 3.3b show the improvements of FM radio reception using a directional antenna. The results show that the use of a directional antenna can improve the reception of FM radio signals. In the case of a monopole antenna, the reception is not as good as when using a directional antenna. Therefore, the use of a directional antenna is recommended for improving FM radio reception.
5.2 Development of directional antennas

5.2.1 Front-installed antennas

- The antenna is designed for front installation and omni-directional reception. It covers a wide area with minimal obstructions. The antenna's performance is optimized for urban and suburban environments.
- The antenna is compact and lightweight, making it easy to install in various locations.
- The antenna's design allows for seamless integration with existing infrastructure.

5.2.2 Rear-installed antennas

- The antenna is designed for rear installation and is optimized for directive reception. It focuses on a specific area, enhancing signal strength and reducing interference.
- The antenna is weather-resistant and can withstand harsh environmental conditions.
- The antenna's design facilitates easy installation and maintenance.

5.2.3 Directional antenna switching control

- The switching control mechanism is designed to automatically switch between different antenna options based on signal strength and reliability.
- The control system is equipped with advanced algorithms to ensure efficient signal capture.
- The switching control ensures that the receiver always receives the strongest possible signal, improving overall performance.
6.1 Block noise reduction during momentary interruption of radio waves

Without freeze control (Large amount of block noise occurs.)

With freeze control (Picture stops just before block noise would occur.)
6.2 Unique in-vehicle design graphics/display functions

6.3 High speed / high quality graphics
Profiles of Writers

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Entered the company in 1976. Since then, has engaged in development of in-car broadcast receiver and antenna. Currently, the Department General Manager of the Antenna System Engineering Department of Engineering Division 1, CI Group and R&D Department of Research & Development Group.

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Conclusion

- The results of the experiments show that the proposed method effectively improves the signal quality of the in-car broadcast receiver in noisy environments.
- The proposed method is also effective in improving the signal quality of the in-car digital broadcast receiver.
- Future work will focus on further improvements to the proposed method and testing it in real-world environments.

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