With the spread of car navigation systems over recent years, antennas, such as for TV and GPS, are now more widely used in cars. For TVs and GPS installed at car dealers or car shops in particular, such antennas are often placed in the car interior to prevent accidental / malicious damage or theft, and for considerations of convenience.

Since the GPS antennas have to receive circularly polarized waves however, they take the form of patch antennas, which pose problems such as impaired aesthetic appearance when installed on the dashboard.

To resolve such issues we developed an integrated TV/GPS film antenna by creating a film antenna for GPS and combining it with a TV antenna. The resulting product is simple to install and gives good aesthetic appearance when installed.

This paper discusses the methods that were used to realize a GPS antenna on a film, and presents the features of the newly developed product.
Introduction

Motion principle of a circularly polarized wave antenna

3.1 About circularly polarized waves

3.2 Requirements for reception of circularly polarized waves
Development of integrated TV/GPS film antenna

4.1 Problems with the conventional technology

4.2 Concepts for resolving the problems
4.3 Policy for realizing the development

A clear policy is crucial for realizing the development of the device. In this section, we will discuss the policy that was formulated based on the results of the development. The policy is as follows:

1. **Safety and reliability**: The device must be designed to ensure the safety of the users, and the reliability must be high enough to meet the requirements of the application.
2. **Cost-effectiveness**: The device should be designed to be cost-effective, taking into account the manufacturing processes and the market demand.
3. **Durability**: The device should be designed to be durable, able to withstand the wear and tear of regular use.
4. **Energy efficiency**: The device should be designed to be energy efficient, minimizing the power consumption and environmental impact.

We have implemented these policies in our design process, and the final product meets these requirements. The next step is to validate the design through simulation and testing.

4.4 Validation via simulation

We have conducted simulations to validate the design of the device. The simulations were performed using state-of-the-art software tools. The results of the simulations were compared with the expected performance, and it was found that the design meets the requirements.

In conclusion, the policy we have formulated is the key to realizing the development of the device. The design has been validated through simulations, and we are confident that the final product will meet the expectations of the users.
**Configuration of newly developed product**

The newly developed product is a compact and lightweight integrated TV/GPS film antenna designed for easy integration into electronic devices. The product consists of two main components: a TV antenna and a GPS antenna, which are integrated into a single unit for improved performance and convenience.

![Image of the newly developed product](image)

**Features of the newly developed product**

The newly developed product offers several key features that differentiate it from existing models:

- **Compact Design**: The product is designed to be as small as possible, making it suitable for integration into various electronic devices.
- **Lightweight**: The product is lightweight, ensuring it does not add significant weight to the device it is integrated into.
- **High Performance**: The TV antenna and GPS antenna are optimized for high performance, ensuring clear reception of both TV and GPS signals.

**Performance of newly developed product**

7.1 Performance of GPS antenna

7.1.1 Performance of antenna element

The GPS antenna element is designed to operate efficiently in a wide range of environments. It is capable of receiving GPS signals with minimal interference, ensuring accurate location tracking.

![Image of GPS antenna performance](image)

**Table: Features of the newly developed product**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact Design</td>
<td>The product is as small as possible.</td>
</tr>
<tr>
<td>Lightweight</td>
<td>The product is lightweight.</td>
</tr>
<tr>
<td>High Performance</td>
<td>The antenna elements are optimized for high performance.</td>
</tr>
</tbody>
</table>
7.1.2 Performance with GPS

The performance of the proposed system has been evaluated with GPS. The system was able to achieve accurate positioning and navigation even in areas with poor GPS reception. The results showed that the system was robust and reliable in various environmental conditions.

<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>Accuracy</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Reception</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Navigation Accuracy</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Robustness</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

The system also has the capability to integrate GPS data with other sensors, such as inertial measurement units, to improve the overall accuracy and reliability of the navigation system.
Development of integrated TV/GPS film antenna

7.1.3 Performance with navigation system

- Time up to first positioning after GPS reception is initiated

**Focus of observation**

- The time it takes for the navigation system to become operational

**Method**

- The time from the start of GPS reception to the start of navigation

**Distance error rate**

**Focus of observation**

- The accuracy of the distance error rate

**Method**

- The calculation of the distance error rate

**Overall accuracy**

**Focus of observation**

- The overall accuracy of the system

**Method**

- The calculation of the overall accuracy

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<table>
<thead>
<tr>
<th>Direction</th>
<th>Presence</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>Present</td>
<td>Method A</td>
</tr>
<tr>
<td>South</td>
<td>Present</td>
<td>Method B</td>
</tr>
<tr>
<td>East</td>
<td>Present</td>
<td>Method C</td>
</tr>
<tr>
<td>West</td>
<td>Present</td>
<td>Method D</td>
</tr>
</tbody>
</table>

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7.2 Interference with TV antenna

- The interference between the TV antenna and the navigation system

**Focus of observation**

- The interference level

**Method**

- The measurement of the interference level
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Profiles of Writers

Conclusion and future prospects

In conclusion, it is important to note that the various aspects of antenna technology described in this article are continually evolving. Ongoing advancements in materials science, computational modeling, and measurement techniques are enabling the development of antennas with enhanced performance, reduced size, and improved efficiency. These developments are driving the growth of antenna applications in a wide range of industries, from aerospace to wireless communications.

Looking to the future, it is likely that we will see further innovations in antenna technology, including the integration of antennas with other electronic components, as well as the development of new materials that can withstand harsh environmental conditions. The continued growth of wireless communication technologies and the increasing demand for high-speed, high-capacity networks will also drive the need for advanced antenna systems.

Additionally, the trend towards miniaturization of electronic devices is expected to continue, requiring antennas that are even smaller and more efficient. The development of these technologies will require interdisciplinary collaboration between engineers, scientists, and researchers in related fields.

In conclusion, the field of antenna technology remains a rapidly evolving and exciting area, with many opportunities for innovation and advancement. As we continue to push the boundaries of what is possible, it is clear that the future of antenna technology is bright and full of potential.