逐条分析

\begin{itemize}

\item Wire-Guided:

\begin{itemize}

\item An energized wire is rooted along the guide path.

\item The antenna of the AGV follows the rooted wire.

\end{itemize}

The outdoor crop field is very large compared to the indoor factories. It is too expensive to root wire under ground in advance. And because of the variety of the temperature and humidity, the wire is easy to be eroded.

\item Optical:

\begin{itemize}

\item Colorless florescent particles are painted on the concrete/tiled floor.

\item Photosensors are used to track these particles.

\end{itemize}

It is impossible to paint the colorless florescent particles on the soil.

\item Inertial:

\begin{itemize}

\item The guide path is programmed on a microprocessor which is fixed on the AGV.

\item Sonar system is incorporated for finding obstacles.

\end{itemize}

Sonar system cannot be used as a guide system in an open area.

\item Infrared:

\begin{itemize}

\item Infrared light transmitters are used to detect the position of the vehicle.

\item Reflectors are affixed on the top of vehicle to reflect the light.

\end{itemize}

It is hard to detect the position of the vehicle by using infrared light transmitters in under sunlight.

\item Laser:

\begin{itemize}

\item Laser beam is used to scan wall-mounted bar-coded reflectors.

\item Accurate positioning can be obtained.

\end{itemize}

This is using for a very close distance to enhance accuracy.

\item Teaching type:

\begin{itemize}

\item AGV learns the guide path by moving the required route.

\item Sends the information to the host computer.

\end{itemize}

The outdoor ground is rough and unpredictable. It is hard to stay in the planned route by just memorizing it. Because small errors of moving on rough ground cumulates to big errors.

\end{itemize}

It is obvious that none of the indoor AGVs guide systems are suitable for outdoor AGVs.

\section{Sound guide}

The sound guided vehicle was implemented with one buzzer ,which mounted on the vehicle ,and three sound receivers. Just like human can detect the position of sound source by using two ears, there was a algorithm designed with the same principle to detect the position of the buzzer. (Figure 2.1)

\begin{figure}[ht!]

\begin{center}

\includegraphics[scale = 1]{soundguided.png}

\caption{Sound guide System}

\end{center}

\end{figure}

On the vehicle side, the buzzer keeps emanating a cyclical audio pulse with specific signal frequency. On the guide system side, computer recognizes and picks up the audio pulse from all three receivers. According to the time differences of receiving the same pulse, the developed algorithm is able to locate position of the vehicle. With knowledge of the vehicle location, guide system can send the action command. The result of the experiment shows that the error is about 1 - 5 $cm$ under a velocity of 6 - 12 $cm/s$.\cite{yuping2011sound}

Most of agricultural operation is under an open area condition. Typically the a single crop field is beyond 200 $m$ in length or width. It is difficult to recognize a sound signal with this range of distance. High resolution microphone must be used so that it can pick up weak signal from a farther distance. However, solving the long distance problem is not only just using a more expensive microphone to pick sound. The average speed of sound is 340 $m/s$ in air, and the actual speed vary along the density of air. In another word, altitude, atmospheric pressure, and humidity all can change the speed of sound. And because of the microphone is more sensitive, noise filtering is also another challenge. Hence, sound guide is not suitable for agriculture applications.

**a contour bank (raised ridge for diverting water)**

**The largest diversion at around 300m occurs while the robot is driving at an angle over a contour bank (ridge). The rows are likely to not have been straight in this location since GPS guided tractors commonly do not compensate for the tilt of the vehicle as they drive at an angle over contour banks causing the planted rows to wobble.**