**深 圳 大 学 实 验 报 告**

**课程名称： 现代通信原理**

**实验项目名称： 实验二**

**学院： 电子与信息工程学院**

**专业： 电子信息工程**

**指导教师： 陈真**

**报告人： 余韦藩 学号： 202028510 班级： 文华班**

**实验时间： 2023.03.08-2023.03.15**

**实验报告提交时间： 2023年3月23日**

**教务部制**

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| **实验目的与要求：**  微信截图_20230323000645 |
| **内容和步骤：**   1. **Initial the potential parameters and generate the original m(t) signal**   Here we set the original signal m(t)=cos(w0t) where w0=20pi. In addition, we set sample rate Fs=4000, carrier frequency Fc=1000 and DC component=2. The following figure shows the main codes for this part.  微信截图_20230323001750   1. **Generate the AM modulated signal (DC component is 2, carrier frequency be 1kHz) and recover modulation signal from AM with envelope detector**   As shown in the following figure, the modulation formulation is marked by the red rectangle. We should add the DC component for the original signal m(t) then multiply the carrier signal which is cos(2×pi×Fc×t).  微信截图_20230323001413  In addition, we also draw the upper and the lower envelop of the AM modulation signal by using the built-in function “envelop”. Next, we recover the modulation signal by envelop detector. Here we use the built-in function “hilbert” to obtain the upper envelop of the modulation. In order to recover the original, we should subtract the DC component for the upper envelop. The main codes are shown in the following figure.  微信截图_20230323204705  The following figure shows the original signal, AM modulation signal and AM demodulation signal in time domain. From the figure, we observe that the modulation signal and demodulation signal has small abnormal place where the start and the end of the signal. That may be caused by the low simple rate. However, the experimental result is almost consistent to the theoretical result. The recover signal is consistent to the original signal.  experiment_2_01  We plot the corresponding result in frequency domain and its main codes are shown in the following figure.  微信截图_20230323001842  The following figure shows the original signal, AM modulation signal and AM demodulation signal in frequency domain. From the figure, we observe that the frequency spectrum of original signal and recover signal is consistent which indicates the success of our experiment.   1. **Generate the AM and DSB modulated signal ( carrier frequency be 1kHz) and recover modulation signal from DSB with synchronous demodulation**   As shown in the following figure, the modulation formulation is marked by the red rectangle. We multiply the original signal with the carrier signal which is cos(2×pi×Fc×t).  experiment_2_02  微信截图_20230323001447  In addition, when the receiver recover the signal, he should multiply the local carrier signal which is cos(2×pi×Fc×t) since we use synchronous demodulation (that means no bias frequency, no bias phase). It is worth to say that the we should use a low past filter to filter the extra signal with 2w0 frequency where w0 is Fc. In the experiment, we use the built-in function “fir1” as low pass filter and determine that 26 is the best order for it. Then, in order to obtain the recover signal, we should amplify the amplitude of the filtered signal. The main codes are shown in the following figure.  微信截图_20230323204748  The following figure shows the original signal, DSB modulation signal and DSB demodulation signal in time domain. From the figure, we observe that the modulation signal and demodulation signal has small abnormal place where the start of the signal. That may also be caused by the low simple rate. However, the experimental result is almost consistent to the theoretical result. The recover signal is consistent to the original signal except for the start.  experiment_2_03  We plot the corresponding result in frequency domain and its main codes are shown in the following figure.  微信截图_20230323001913  The following figure shows the original signal, DSB modulation signal and DSB demodulation signal in frequency domain. From the figure, we observe that the frequency spectrum of original signal and recover signal is consistent which indicates the success of our experiment.   1. **Generate the PM modulated signal**   It is easier to implement the PM modulation since the formulation is given where wo is 2×pi×Fc. We just plot the Sp(t) which shown in the following figure that we finish PM modulation.  experiment_2_04微信截图_20230323001507  The following figure shows the main codes. We plot the original signal and PM modulation signal in time domain and frequency domain. Since the process is so easy that I will not explain it in detail. Just have a show. The notes in the program are enough to understand each part of the codes.  微信截图_20230323204853  The following figure shows the original and PM modulation signal in the time domain.  experiment_2_05  The following figure shows the original and PM modulation signal in the frequency domain.  experiment_2_06 |
| **实验结论：**  Though this experiment, we modulate the m(t) signal by AM, DSB and PM modulation. And successfully recover the modulation signal for AM and DSB modulation. In fact, there are some advantages of the AM, DSB and PM modulation. Here I summarize these advantages respectively.  **The advantages of AM modulation include:**   1. Simple implementation: AM modulation is relatively easy to implement, as it only requires a modulator and a demodulator. 2. Easy reception: AM signals are very easy to process and demodulate on the receiving end, as they contain a DC component and a low-frequency information signal. 3. Wide bandwidth: AM modulation can transmit information over a relatively wide frequency band, as its modulation frequency is relatively low. 4. Suitable for long-distance transmission: AM modulation can be transmitted through ground waves and antenna waves, making it suitable for long-distance transmission. 5. Suitable for voice transmission: AM modulation is well-suited for transmitting voice signals, as the frequency range of speech signals is relatively low. 6. Provides some degree of noise immunity: AM modulation can provide some degree of noise immunity by increasing the signal-to-noise ratio.   **The advantages of DSB modulation include:**   1. Higher power efficiency: DSB modulation is more power efficient than AM modulation, as it does not transmit a carrier signal, resulting in less wasted power. 2. Better frequency utilization: DSB modulation uses less bandwidth than AM modulation, resulting in better frequency utilization. 3. Improved signal quality: DSB modulation produces a higher quality signal than AM modulation, as it does not suffer from the distortion and noise that can affect the AM signal. 4. Suitable for data transmission: DSB modulation is well-suited for transmitting data signals, as it has a high data transfer rate and can transmit binary signals. 5. Easy implementation: DSB modulation is relatively easy to implement, as it only requires a modulator and a demodulator.   **The advantages of PM modulation include:**   1. Improved noise immunity: PM modulation provides better noise immunity than AM modulation, as it maintains a constant amplitude and varies only the phase of the carrier signal. 2. Efficient use of bandwidth: PM modulation uses bandwidth more efficiently than AM modulation, allowing for higher data transfer rates. 3. Easy to demodulate: PM signals are relatively easy to demodulate, as they only require a phase detector. 4. Suitable for data transmission: PM modulation is suitable for transmitting digital data, as it can transmit binary signals. 5. High spectral efficiency: PM modulation has high spectral efficiency, as it can transmit multiple signals in a single frequency band. 6. Improved signal quality: PM modulation produces a higher quality signal than AM modulation, as it does not suffer from the distortion and noise that can affect the AM signal. |
| **指导教师批阅意见：**    **成绩评定：**  **指导教师签字：**  **年 月 日** |
| **备注：** |

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2、教师批改学生实验报告时间应在学生提交实验报告时间后10日内。