The design of Handheld Stabilizer with Follow Focus Function

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Abstract. In this paper, we design a follow focus system, which can be integrated with a handheld stabilizer. The follow focus system of the handheld stabilizer includes the following steps: establishing communication relationship, signal input, signal transmission, focusing control and adjusting camera parameters. The follow focus system solves the problem that the parameters of the follow focus and the platform need to be adjusted by both hands. It optimizes the problem of wire winding in stabilizer, while it combined with the follow focus wired control. It indirectly shortens the response delay of the wireless follow focus by using the internal wiring of the stabilizer. It achieves not only adjusting the camera parameters, but also stabilizing the follow focus of the real-time camera.

1. Introduction

With the popularity and maturity of the Internet, consumers’ demand for Internet-based content consumption and social networking is increasing. Traditional text and image forms cannot meet the current user needs. Video has become a more preferred way of content dissemination for users.

The first stabilizer that can be worn on a photographer for photography is Steadicam shown in figure 1, which photography quality is directly proportional to the skill and experience of the operator[1]. The whole system is heavy and its flexibility is not as well as that of the electronic stabilizer. Electronic stabilizer, i.e. platform system, and the three-axis platform system shown in figure 2 is the most common one[2-3]. The electronic stabilizer is compact, portable, easy to use and easy to carry, but because the stabilizer does not have its own focusing device in the shooting process, it is limited in shooting motion lens.
At present, the focus tracker has been widely used in the field of photography. In the field of handheld stabilizer, the extended follow focus still needs to adjust the parameters of the follow focus and stabilizer by both hands, which reduces the reliability and shooting efficiency of the stabilizer.

In view of the above problems, this paper designs a focus tracking system integrated in the handheld stabilizer, which solves the problems of adjusting the parameters of the tracking device and the platform through both hands, winding the traverse of the stabilizer, delayed shooting, poor user experience, low reliability of the stabilizer and low shooting efficiency in the existing technology. It realizes not only adjusting camera parameters, but also realizing the stabilizer following focus system of the real-time camera.

2. Focusing Method
Focus tracking means that the camera adjusts the focal length according to the displacement of the subject, to keep it in the precise focus, and to ensure that the picture of the subject keeps good clarity. The function of the follow focus is to control the focus of the lens in real time in dynamic video shooting. It is more accurate and stable than the traditional hand-twisted lens.

2.1. Autofocus
DSLRs (Digital Single Lens Reflex) are designed to take still images, so there are some problems when using DSLR to take video, for example, it cannot operate as easily as video camera. For this reason, the camera company has designed an auto-focusing function for DSLRs[4]. As shown in figure 3, it can achieve high-tracking and high-speed focusing in short film shooting[5-7].

![Figure 3. Autofocus lens.](image)

![Figure 4. Manual focusing.](image)

However, as far as user feedback is concerned, this autofocus method is only suitable for static scenes and can quickly adjust the focus when the scene changes slowly. When shooting dark areas or small contrast and moving subjects with complex motion conditions, it is easy to occur that automatic focusing cannot be aligned. The viewer can clearly detect the jitter of defocusing-focusing-defocusing in the process of automatic focusing.

Using DSLRs to shoot high-end videos, professionals recommend full manual focusing.

2.2. Manual Focusing
Manual focusing is a method of focusing that can adjusts the camera lens by turning the focusing ring manually to make the shooting result clear. This method largely depends on people’s recognition of the image-on the focusing screen, the proficiency of the photographer and the visual acuity of the photographer.

In addition, rotating the focus ring of the follow focus directly with your hand, you can also use some auxiliary equipment, such as the follower whip and crank. But they still can’t overcome the problems of awkward holding posture, poor manoeuvrability, poor stability, wire winding and adjusting the parameters of follow focus and platform with both hands even when using the platform.

Visible, direct manual focusing with a DSLR camera will consume manpower, affect stability, cause the wire wrapping around the camera body, and also need certain requirements for the shooting
environment. The ideal video shooting can be accomplished by indirect manual focusing using with a follow focus.

2.3. Wireless Focuser

The follow focus has a follow-focus handwheel and a set of follow-focus driving motors. The rotation of the follow-focus handwheel is converted into the rotation of the follow-focus driving motor, and then it is converted into the rotation of the gears on the lens focus ring. It is very cumbersome to shoot many following shots when there is no wireless follow focus.

Wireless follow focus is derived from the manual focus operation. When there is no wireless follower, many follow-up lenses are required. It is necessary to follow the photographer with a dedicated follower, as shown in figure 4. It is very troublesome. When shooting a running lens, or when the shooting environment is limited, you can use the wireless follow focus, shown in figure 5. The follower can see the follower picture clearly and complete the follower with a main handwheel of the follower as shown in figure 6.

![Figure 5. Actual use of wireless follow focus.](image1)

![Figure 6. Focuser handwheel and driving motor.](image2)

However, the wireless focus cannot achieve the function of using the SLR camera to shoot films independently, and the wireless follow focus is affected by various radio signals in the studio, so the anti-interference requirement is high. Wireless operation also causes slight delay.

3. Our design of focusing system

When a DSLR shoots video, it is necessary to control the focus of the lens in real time. DSLR auto-focusing function is difficult to achieve precision and stability, and it is easy to make the lens jump. On the one hand, direct manual focusing requires a high degree of professional proficiency with the follower. On the other hand, the manual focus is limited by the environment. The wire control device of the follower is directly applied to the handheld stabilizer, which is also prone to wire entanglement. The wireless follow focus can achieve remote control, but it usually needs to be equipped with a jockey and a videographer to complete the shooting. Wireless control has a slight delay and there is a probability of dropped. In order to make the shooting more stable, the tracking more accurate, the operation is convenient, the equipment is simplified, and the handheld stabilizer tracking system is an inevitable development trend.

Stabilizers or platforms, especially handheld stabilizers, have many internal components and circuits, and have high integration. Generally, only one USB interface is set for products. In the application of stabilizer field, whether it is wired or wireless communication, the follower still needs to be controlled by a separate controller. When users use the stabilizer, they need to adjust the parameters of the follower and the stabilizer manually, which makes the user experience worse. In the application of the handheld stabilizer field, because the control panel area of the handheld stabilizer is small, users need to rotate the follower handwheel to adjust the two system parameters, which reduces the reliability of the stabilizer and reduces the shooting efficiency. The control device of the follower is directly applied to the handheld platform, which is liable to produce the phenomenon of wire winding in the process of using. Some existing stabilizer can adjust the internal parameters of the camera, including the follow-focus control of the camera. However, at present, this technology can
only achieve the follow-focus control of some brand cameras, which can only be controlled through the open data interface of the camera manufacturer. The price of the stabilizer is higher and the replacement cost is higher. In summary, in the existing technology, there is no scheme that can adjust camera parameters and realize camera focus control because of the original stabilizer structure.

As shown in figure 7, the focus system mainly includes (1) a stabilizer, (2) a focus drive motor, a stabilizer handle provided with (3) a focus signal input unit, and a follower includes (4) a follow focus ring. The follow focus ring is mounted on the lens focus ring, and the sawtooth on the focus ring is engaged with the gear on the camera focus ring. The rotary focus signal input unit is the focus dial shown in figure 8, which drives the lens focus ring to rotate to achieve precise control of the focus point. The angle of rotation with the focus wheel is converted to a focus signal.

Figure 7. Diagram of stabilizer with follow focus.

After the follower is integrated into the stabilizer, the follower turns from wireless to wired, and the line is placed in the stabilizer skeleton, which solves the problem of wire winding and solves the problem of wireless follower delay. The focal unit reduces the wireless transmitter and the wireless receiver. The power supply system of the follower’s motor is provided by the stabilizer. The follower only needs to keep the motor and some electronic chips to control its speed, simplifying the equipment, and the cameraman can complete the operation independently. When shooting the motion following lens, the distance from the subject to the lens will change, but in general the camera cannot achieve automatic focus, manual focus will affect the stability of the stabilizer, the stabilizer should try to avoid external force interference during the working process, so as much as possible to concentrate everything on the stabilizer itself, it will not be interfered by external forces.

Referring to the schematic diagram of the stabilizer, the follower and the series follow-focus system of the camera is shown in figure 9, the working method of the follow-focus system mainly includes the following steps:

- Establish the communication relationship between the follow focus and the stabilizer, the follow focus and the photographic equipment.
- Signal input, the focus signal and the photographic equipment adjustment signal are input through the focus signal input unit and the control module, that is, the operation button and the direction remote sensing.
- Signal transmission, the focus signal is transmitted to the focus ring, and the parameter adjustment signal of the photographic equipment is transmitted to the photographic equipment.
- Parameter adjustment, corresponding to the execution module, the focusing ring makes corresponding focusing action according to the received focusing signal, and the photographic
equipment makes corresponding parameter adjustment according to the received parametric adjustment signal.

Figure 9. The diagram of the focusing system in series with the stabilizer, the follow focus and the camera.

The stabilizer designed in this paper includes a detection module for detecting whether the stabilizer has a device connection. The stabilizer also includes an identification module for identifying whether the connected device is a follow focus. When the stabilizer is simultaneously connected to the photographic equipment and the follow focus, if the identification module recognizes that the stabilizer is connected to the follow focus, the follow focus will receive the focus signal and perform external focus task. The priority of the focus control avoids the error of signal transmission when the connection is simultaneous. If the identification module recognizes that the connected device is a photographic device, the focus signal input by the input module is transmitted to the photographic device, and the electronic device inside the photographic device is executed focal. The input signal of the input module is not only used to control the follow focus. When the stabilizer is connected with the photographic device of the open adjustment parameter data interface, the input signal of the input module is used to control the electronic focus of the photographic device. By combining the focus control inside the photographic equipment and the focus control of the external follow focus, the stabilizer can control the focus of various photographic equipment and expand the function of the stabilizer.

4. Conclusions

In this paper, a focusing system integrated with a handheld stabilizer is designed. In order to prevent the stabilizer from being disturbed by external forces, concentrate all the devices on the stabilizer itself. After the follow focus is integrated into the stabilizer, using only one set of hardware devices, the camera operator can independently perform clear shooting of the motion following lens. The stabilizer lays the follow-up signal transmission line along the path of the internal conductor of the stabilizer to the load support plate of the stabilizer or the motor casing connected to the load support plate. There is no excessive bare conductor, and there is no follower control device independent of the stabilizer, which simplifies the device.

This simplifies the equipment and solves the wire winding problem on the stabilizer. External Focus Following Controller is used to solve the compatibility problem of multi-model cameras.

Because of this fast and friendly designs, video creators no longer worry about the smoothness and stability of the picture, so they can concentrate on the idea and design of film shooting.
Acknowledgments
This work was supported by major special projects of Guangxi science and technology (NO.AA18118009).

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