Near Infrared High Resolution Imaging Camera System

1. The 2.16m Telescope

The largest telescope made in China was installed at Xinglong station of Beijing Observatory. The clear aperture of the primary mirror is 2.16m and its f-ratio 3 (f/3). There are three foci in this telescope; Cassegrain (f/9), coudé (f/45) and prime focus.

2. Adaptive Optics System

An Adaptive Optics System will be mounted at the coudé focus on an optical table. It will be serviced to remove the effect of atmospheric turbulence on the imaging observations and to improve the spatial resolution. A 21-elements adaptive optics system would be used to equip the 2.16m telescope for near infrared observations. The optical layout is as shown in Fig. 1.

M0 is a mirror, which reflects the light from the telescope to the A0 system. M1 is a spherical mirror as collimator. The light beam size will be fitted to the size of a wavefront corrector. The wavefront corrector consists of two tip tilt mirrors and a 21-elements deformable mirror (DM) driven by piezocrystals. The first tip tilt mirror (TM1) is used to correct the low frequency (2.5Hz) and large amplitude Image movement caused by atmospheric turbulence and the tracking error from the telescope. The control signal of TM1 is from an image Tube+CCD system (I-CCD) and a position error detective system. The second tip tilt mirror (TM2) is used to correct the high frequency (2.5–10Hz) and small amplitude image movement. The deformable mirror (DM) is used to correct the high-order aberration caused by the atmosphere.

The TM2 and DM are driven by a control signal from a wavefront detector and processor. A dichroic mirror S2 splits the light into two beams, one optical and the other infrared. The optical

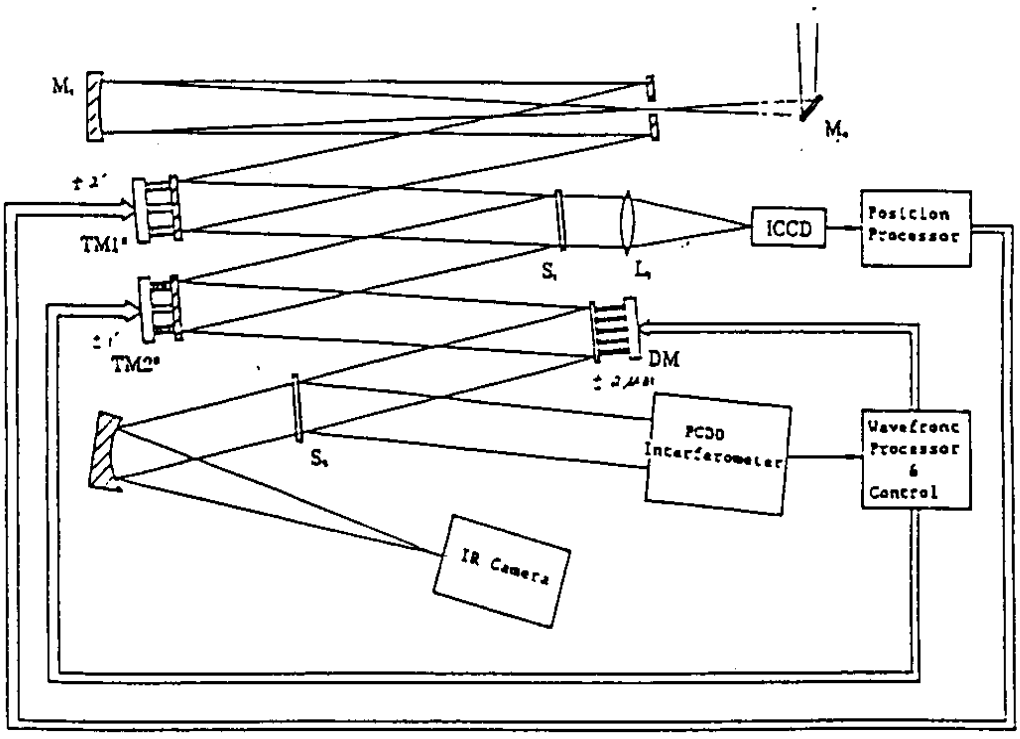

Figure 1. Optical layout of the Adaptive Optics System.

beam is used for wavefront detection. In the system the wavefront detector is a photon counting dynamic differential interferometer. It can measure the wavefront tilt at each element in the direction of X and Y. The wavefront processor gives a control signal to drive the TM2 in two directions and drives a piezocrystal element in the DM.

The total deformable elements are 21. In the X and Y directions there are 32 sub-apertures to detect the wavefront deform. The size of each sub-aperture is about 40 cm. It is fitted with the size of r0 at 2 μm.

The A0 system works as a loop-locked control system. It could correct the deformation of the wavefront due to atmospheric turbulence and prove the spatial resolution of astronomical near infrared imaging observations. It is hoped to reach the diffraction limitation i.e. for the 2.16m telescope this is about 0.3 arcsec.

3. The PtSi Infrared Camera

The 512 x 512 PtSi IR CSD (Charge Sweep Device) which was developed by the Mitsubishi Electric Company of Japan has been selected for the detector of the camera system. The PtSi Schottky-Barrier diode array does not have high quantum efficiency but has an excellent uniformity and stability, a large format size and a low read-out noise. In this case the PtSi image sensor is more effective than a high quantum efficiency detector with small format.

This camera system is shown in Fig. 2. The total system contains: Camera Dewa (Flank Low HDL-8), the PtSi IR CDS is cooled by a solid nitrogen down to 52K; Preamplifier and A/D Converter (ADC 4322, 16 bits, 2MHz); Clock Pattern Generator (CPG); Frame Memory; Host Computer (Sun workstation).

The wavelength range is 1 - 2.5 μm with both wide band filters (J.H.K) and narrow band filters. The Optical Focus Reducer for the Cassegrain focus is f/3 (0.6"/pixel); 5.0′ x 6.0′) and f/6 (0.3"/pixel; 2.5′ x 3.0′) without adaptive optics system.

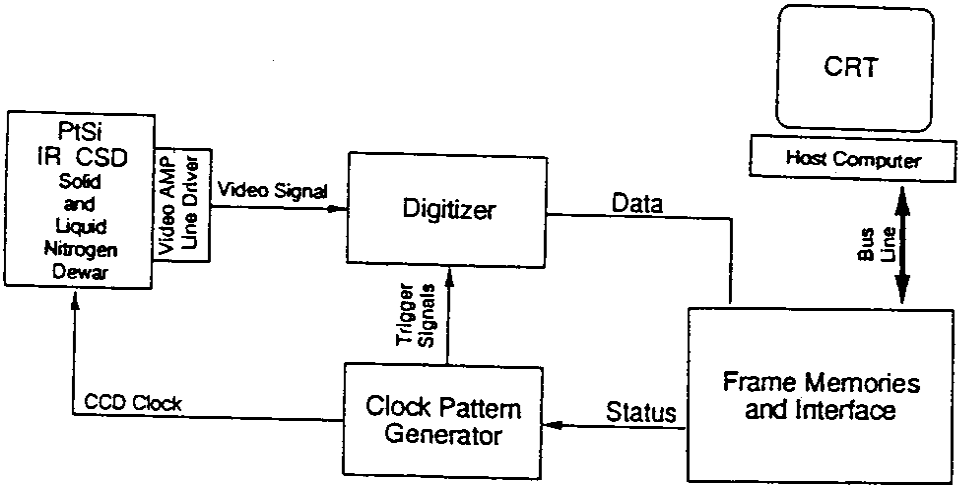

Figure 2. The block diagram of the PtSi IR camera system.

Acknowledgements

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References

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