

Part I Introduction of the CCD Stereo Camera

CCD Stereo Camera

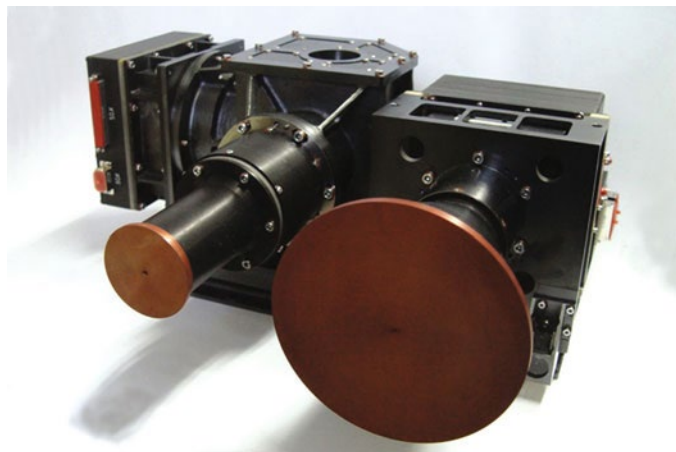
CE-1's optical sensor is a three-line-array CCD push-broom camera. The camera is loaded on a big area array CCD detector, reading the 11st, 512nd, and 1013rd rows perpendicular to the direction of flight. The data are regarded as the front, nadir and back image arrays, of which the pixel is 512 columns, and the view angle between adjacent arrays is 16.7° . Based on the predetermined in-orbit flight parameters, the camera's scanning speed is set to be 11.89 f/s, to ensure that the satellite's three-line-array scanning can obtain consecutive image data on front, middle, and back angles (See in [Fig. 1.1](#)). The main specifications of three-line-array CCD stereo camera are shown in [Tab. 1.1](#).

Characteristics of Orbits and Attitudes

The design parameters of CE-1 circumlunar orbits and attitudes are as follows ([Tab. 1.2](#)):

(1) Orbital data in operation

CE-1's actual dynamic range of orbit altitude is from 195.53 km to 202.07 km, with an average of 197.19 km; the dynamic range of orbital eccentricity is from 0.00017 to 0.012293, with an average of 0.006349; the dynamic range of orbital inclination is from 87.6° to 90.0° , with an average of 88.20° .



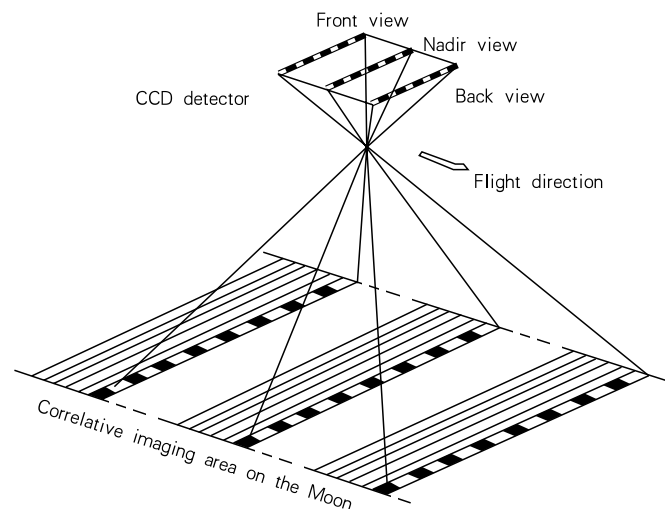
[Fig. 1.1](#) CCD Stereo Camera

(2) Attitude data in operation

The attitude is relatively stable: more than 95% of attitude values are less than 0.03° and standard deviation of the value of attitude angle to the Moon is less than 0.02° ; 96% of the attitude change rate is less than $0.0016^\circ/\text{s}$; stability of yaw angles and roll angles in orbit coordinates is better than $0.003^\circ/\text{s}$ (3σ); stability of pitch angles is better than $0.008^\circ/\text{s}$ (3σ).

Data Acquisition and Coverage

Because of the adjustment of the orbit attitude, the maintaining of payloads, the global CCD image was finally fulfilled, after 4 covering cycles, in two operation periods, making the time phase of the image data inconsistent. During the first covering cycle, 228 tracks of data in areas of 70°N – 70°S were acquired; in the second period, 247 tracks from 70°N – 70°S and 17 tracks from the polar regions were acquired; and in the third period (till January 27, 2008), 14 tracks from 70°N – 70°S and 58 tracks from the polar regions were acquired. In the second operation period starting from May 1, 2008, 6 tracks from 70°N – 70°S were acquired, fulfilling the data coverage in 70°N – 70°S . Data coverage of the polar regions were fulfilled on July 1.



[Fig. 1.1](#) CCD stereo camera imaging process

[Table 1.1](#) The main specifications of CCD stereo camera

Name	Index
Frame frequency	11.89 f/s
Spectrum range	$0.5 \mu\text{m} \sim 0.75 \mu\text{m}$
Radiometric resolution	8 bit
Focal length	23.33 mm
Pixel per linear array	512
Size of pixel	$14 \mu\text{m} \times 14 \mu\text{m}$
Relative aperture	F/5
Adjacent angle between linear arrays	16.7°
Time of exposure	3.2 ms, 7 ms, 20 ms and 84 ms
MTF	≥ 0.2
S/N ($\rho = 0.2 \theta = 60$)	≥ 100
Imaging width above 200 (km)	L = 60 km
Baseline to height ratio	≥ 0.6
Pixel spatial resolution (subastral point)	120 m

[Table 1.2](#) The design parameters of CE-1 circumlunar orbits and attitudes

CE-1 parameter	Value
Orbital altitude (km)	195.464 ± 25
Inclination	$90^\circ \pm 5^\circ$
Eccentricity	0
Orbital period (min)	127.164
Attitude control precision (three dimensional)	$\pm 1^\circ(3\sigma)$
Attitude change rate (three dimensional)	$0.01^\circ/\text{s}(3\sigma)$