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基于火星探测的人工标志识别定位

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Artificial target recognition and location based on Mars exploration

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摘要 为了实现火星探测中巡视器以及着陆器上人工标志的识别定位,结合好奇号火星车的人工标志特征和火星环境的特点,提出一种人工标志两步识别定位方法。第一步是在图像中识别人工标志并进行初步定位。该步骤通过图像边缘检测,提取并跟踪各轮廓边界。针对人工标志存在的沙尘附着、光照不均、以及阴影遮挡等问题,提出一种基于火星环境的自适应边缘检测方法。采用最小二乘椭圆拟合方法对每一个轮廓边界进行椭圆拟合,将拟合所得的椭圆参数作为标志的初步定位结果。第二步是对各人工标志进行精确定位。根据初步定位的椭圆参数进行图像分割。考虑标志中心为两条直线的交点,故采用Hough变换对各分割出的图像块进行直线检测,并对交点进行重定位,从而得到人工标志的精确位置。对好奇号火星车的标志图像进行了试验,结果表明:提出的方法能够检测存在较大变形的人工标志,对标志中心的定位精度稳定在1个像素以内。该对沙尘附着、光照以及阴影遮挡具有一定的鲁棒性,基本满足火星探测中人工标志定位的精度和鲁棒性要求。

关键词 : 火星探测, 目标识别, 人工标志, 标志定位, 光照鲁棒性

Abstract : To recognize and locate artificial targets of a rover and a lander in Mars exploration, a two-step artificial target location method is proposed by combination of the characters of artificial targets of the curiosity rover with Mars environments. The first step is to recognize the artificial targets in the image and to locate them preliminary. The edge information is obtained by edge detection, and contour feature-points are extracted by edge tracing. As the artificial targets in the Mars surface environment always are adhered and deposited by dust particles and are suffer from the uneven illumination and shadow block,the paper proposes an adaptive edge detection algorithm based on Mars environment. The algorithm uses least square ellipse fitting method to fit and recognize the artificial targets in the image and locate the center of each artificial target preliminary. The secont step is to locate every artificial targets accurately. According to the preliminary result of ellipse fitting, the image is cut into pieces with one ellipse in each piece. Since the center of the artificial target is the intersection point of two intersecting lines, the Hough transform is used to detect the lines. The coordinate of intersection point is relocated and to obtain the center of the artificial target precisely. Experiments are carried out based on artificial target images of curiosity rover. The experimental results indicate that the method proposed can be used in the targets with largely deformation, and the location accuracy is within 1 pixel. The method is robust to the dust adhesion, illumination and shadow effects, and satisfies the Mars exploration system requirements for the resolution and robustness.

Key words : Mars exploration target recognition artificial target target location illumination robust

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