

A Study on Extraction of the Center Point of Steam Generator Tubes

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Abstract

This paper describes extraction procedures for the center coordinates of steam generator tubes of Youngkwang nuclear power plant No. 6 unit. The centering coordinates of tubes are needed for monitoring whether ECT probe is exactly inserted into tube or not. The centering coordinates extraction procedure consists of two steps. The first step is to process the region with high contrast in entire image of steam generator tubes because the tube image tends not to have uniform contrast in entire image, which resulted from poor illuminations because steam generator bowl is sealed. Using the center points extracted in the first step and the geometry of tubes lined up in regular triangle patterns the centering coordinates of the rest region with low contrast are estimated. The straight lines, that is, from center point of a tube to the other center points of neighboring tubes in the horizontal, 60° and 120° directions are derived using center coordinates extracted only in a high contrast image region. Thus, the intersections of straight lines in horizontal direction and slant lines in regular triangular direction are adopted as the center coordinates of tubes in the rest image region with low contrast. The Chi-square interpolation method is used to determine the line's coefficients. In order to estimate the position and pose of camera assembly camera calibration method is also used. Using tubes geometry that tubes are placed on the tube sheet of steam generator with uniform pitch, 1" (25.4mm), in the triangular directions, on behalf of calibration chart, the camera calibration is carried out and the extrinsic parameters of camera assembly is estimated.