Modeling of Rotating Magnetic Field Eddy Current Probe for Inspection of Tubular Metallic Components

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Abstract

Rotating Magnetic Field Eddy current technique is a promising technique for inspection of flaws in metallic tubular components. Three primary coils, which are disposed 120 degrees apart in space, are excited with three phase current source, by virtue, a rotating magnetic field polarised in radial direction is generated. This radial field interacts with metallic tube and generates circulatory eddy currents which have the capability to interact with circumferential as well as axial oriented flaws. An array of pickup coils which are disposed on a circumferential plane on the outer tool body, where each pickup coil picks up signals from the associated circumferential sector of the metallic tube which in the vicinity of the said pickup coil. The technique enables to detect flaws in circumferential as well as in axial direction simultaneously. Further with this technique complete circumferential inspection is possible without physical rotation of the probe. The key advantages of the technique are better Signal to Noise ratio, high sensitivity, and good reproducibility.

This paper describes the modelling of Rotating Magnetic Field (RMF) eddy current probe. The schematic model of the Rotating Magnetic Field Eddy current Probe is shown in the figure 1. The modeling was carried out in COMSOL Multiphysics® software to find out the flux distribution as well as the induced current distribution. The induced current distribution is shown in figure.2. The Magnetic Flux distribution of the Rotating magnetic Field Probe is shown in figure 3. The voltage induced in single turn of pick up coil was derived for extracting amplitude and phase information and correlated it to the flaws modeled with varying sizes and at different depth locations. The table.1 shows the amplitude and phase of the voltage induced in the pickup coil for varying flaw sizes and at different depth locations.

Figures used in the abstract

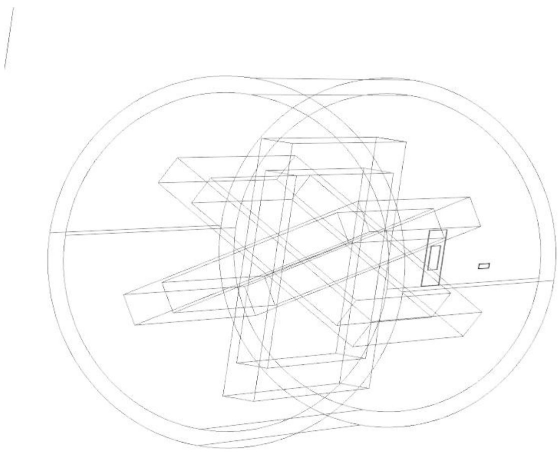

Figure 1: Schematic Model of the Rotating Magnetic Field Eddy Current Probe.

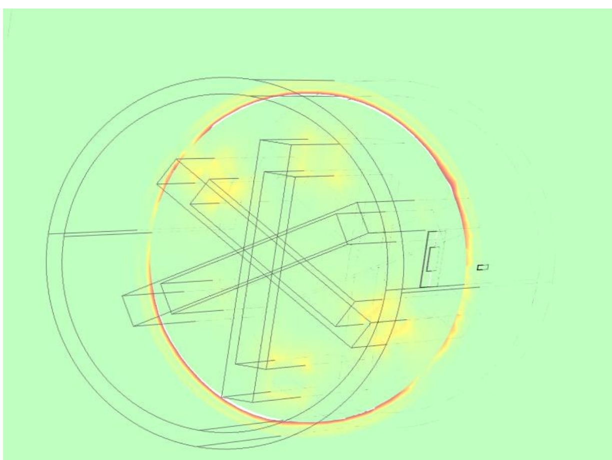

Figure 2: Induced current density distribution in the tublar component.

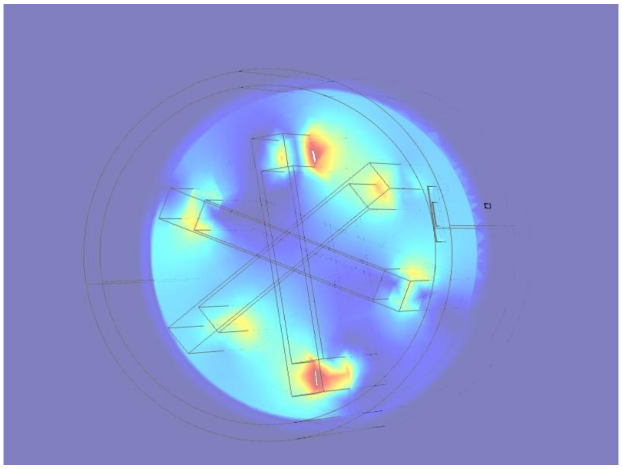

Figure 3: Magnetic Flux density Distribution of the Rotating Magnetic Field eddy current probe.

Flaw Location	**Flaw size 0.1mm**	**Flaw size 0.2mm**	**Flaw Size 0.5mm**
OD	6.5*10^-8 ang-144.94	5.6*10^-8 ang-143.70	1.45*10^-8 ang-144.29
ID	1.89*10^-10 ang 38.14	1.6*10^-10 ang 36.34	1.44*10^-10 ang 33.52
No Flaw	5.45*10^-3 ang-151.65	5.45*10^-3 ang-151.65	5.45*10^-3 ang-151.65

Figure 4: The amplitude and phase of the voltage induced in single turn coil for varying flaw sizes at different depths.