Searchcoil field shape – DD vs. concentric

Dave Johnson, FTP-Fisher 9 April 2012

We've all seen pictures which purport to indicate the shape of the field of a searchcoil. I suppose the most common are a cone shaped field for concentric, and a wedge shaped field running fore and aft for DD's. I'm about to make a statement that not very many people will like: *all pictorial representations of searchcoil fields are false.*

Here's why: Considering only the transmit field, every point in space has four parameters: orientation of the vector in x, y, z - space, and vector magnitude (Impossible to draw a picture of it on a piece of paper).

Then, there's the effective response field of the receiver coil; another four parameters.

Then there's the problem of the target. It has three position parameters, three orientation parameters, at least one shape parameter, and at least one phase parameter; absolute minimum of 8 variables.

We're up to an absolute minimum of 16 parameters so far, and haven't even addressed the question of movement of the target through the field. That's got three direction parameters and one velocity parameter, and now we're up to 20 parameters.

How the actual machine responds to all of this depends on how the signals are processed. For example the response you get in static pinpoint mode is very different from what you get in either auto-tune or second derivative motion discrimination. A rudimentary mathematical description of the differentiators required to implement a simple motion discriminator requires two differentiation gain parameters and four low pass filter constants, totaling 6 variables. So to say what happens when you swing a target past the searchcoil of a simple motion discriminator requires computation of at least 26 variables. I doubt anyone has ever attempted to compute such a thing, although it's theoretically possible. In any case, nobody will ever draw a picture of it.

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To communicate what actually happens, we need some combination of pictures and/or words, and we have to simplify to the point where our description is nothing more than a convenient fiction, or worse yet inconvenient if we misapply it. Here's my convenient fictions du jour, in words, no pictures.

1. In static pinpoint mode, in the 2 to 6 inch range, DD response will tend to be fore and aft and narrow, whereas concentric response will tend to be toward the center axis of the searchcoil. This is generally in favor of the DD.

2. In any mode, in the 0 to 3 inch range, DD response will have stronger anomalies (dead zones, etc.) than a concentric. This is generally in favor of the concentric.

3. In static pinpoint mode, past 6 inches, there isn't much difference in the response between a DD and a concentric.

4. In discrimination mode in the 0 to 5 inch range, the interaction of flat iron response with the searchcoil and machine responses tends to throw the apparent phase of flat iron up into the nonferrous range, and this tendency is a lot stronger with DD's than with concentric. This is generally in favor of the concentric.

5. The interaction of ground with DD searchcoil response is widely regarded as being more benign than with concentric, although whether this is the case in any specific instance depends on what the conditions are.

-- Dave J.