Report on Velocimeter testing at customer's site on May 19-th 2006

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1. Summary

Prototype production unit of Velocimeter, millimeter microwave Doppler sensor for metal strips was tested on a four-stand cold mill while processing steel coils of gauges 0.07-0.2" . The sensor was able to pick up Doppler signal and produce output 4-20mA as a function of the strip velocity, when mounted from a distance of about 30cm from the strip edge (in the second mounting configuration, see below) but not from a distance of 60cm (first mount).

2. Details.

Prototype Velocimeter unit #2 was connected to 24V dc power supply and its 4-20mA output was connected to 10V input of a stripchart recorder with a 250 ohm load resistor. In addition, data was collected into a laptop using a serial RS232/USB data link.

First mount.

First mounting method placed sensor pointing towards the entry to the mill from a distance of about 60-100cm (between antenna end and the strip along the antenna axis. The sensor was mounted rigidly (bolted) to a steel plate, which was then bolted to a moving table. The sensor was mounted slightly above the plane of the strip looking down (at about 10 degree angle). The beam incidence angle to the strip edge was about 45 degree.

Secound mount.

Second mounting method consisted of putting the sensor on the steel table bed beside the strip closer to the place where the coils are fed, away from the rolling assembly stand. Antenna was pointing towards the strip edge slightly from below the plane of the strip looking up at about 10 degree angle, from a distance of about 30 cm to the strip edge. The beam incidence angle to the strip edge was about 45 degree.

Tests begun around 11am and lasted until 3pm, with several breaks. Considerable time was spent logging data and testing various sensor software settings to test sensitivity and determine the optimum software configuration, and test operation against various combination of configuration parameters such as sampling rate (FreqRng), receiver gain (Gain), minimum amplitude threshold (Amp Min) and minimum frequency cutoff (Raw Fmin).

3. Results

Chart recorder results (4-20mA).

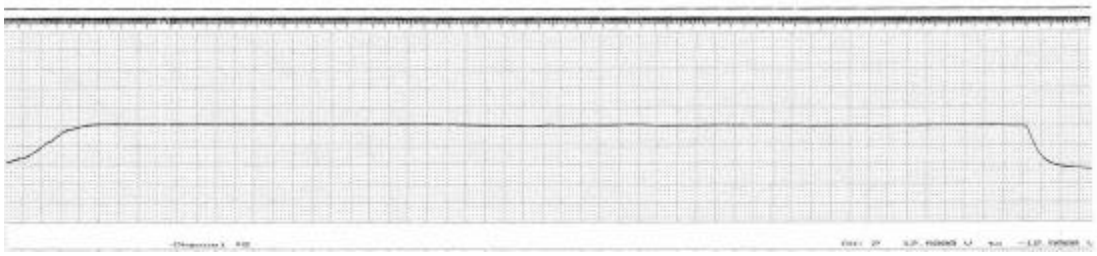


Chart 1

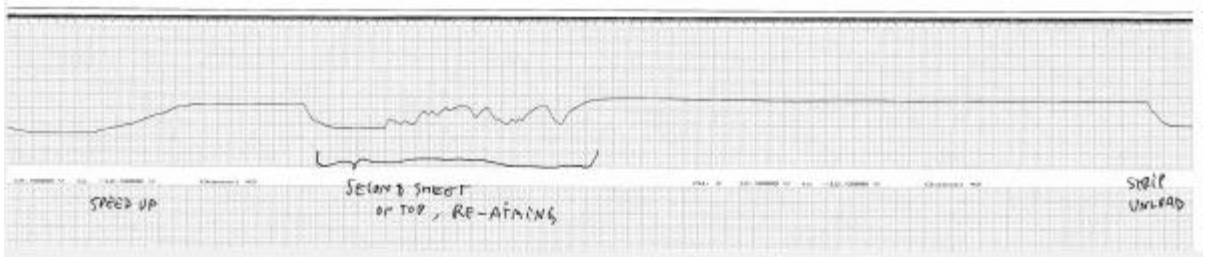


Chart 2. Shows disturbance caused by a second strip head sliding over the strip

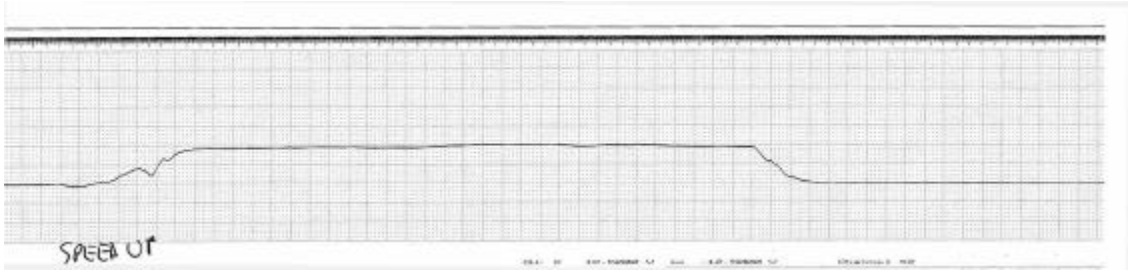
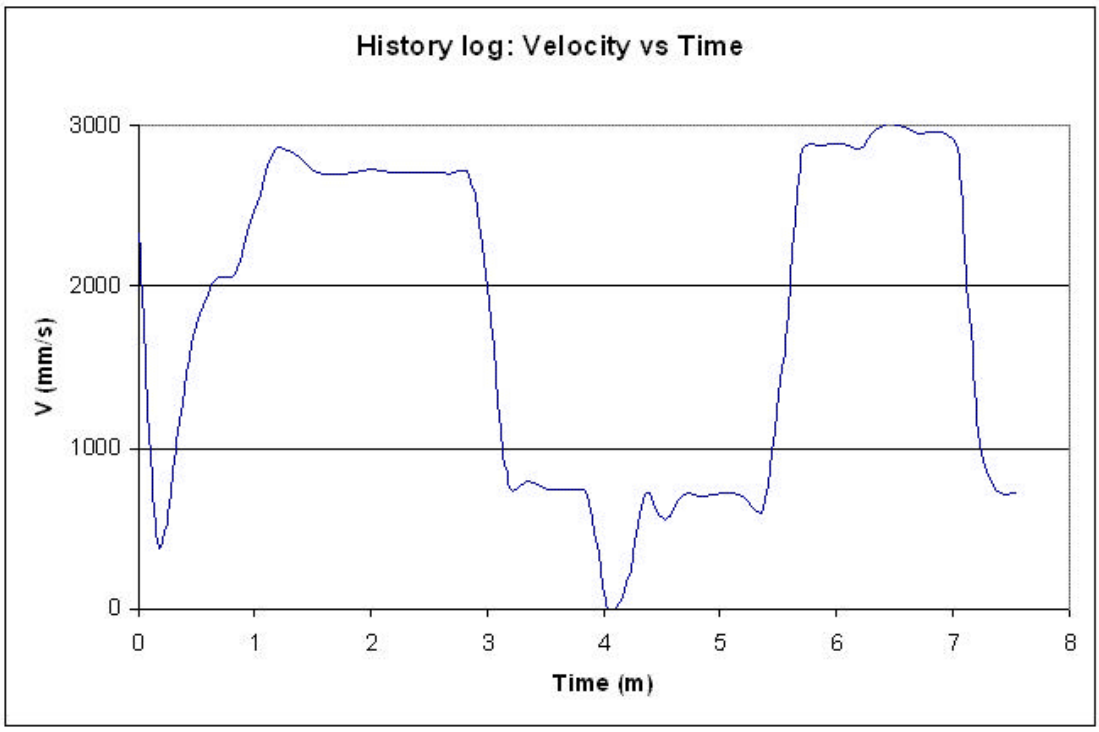


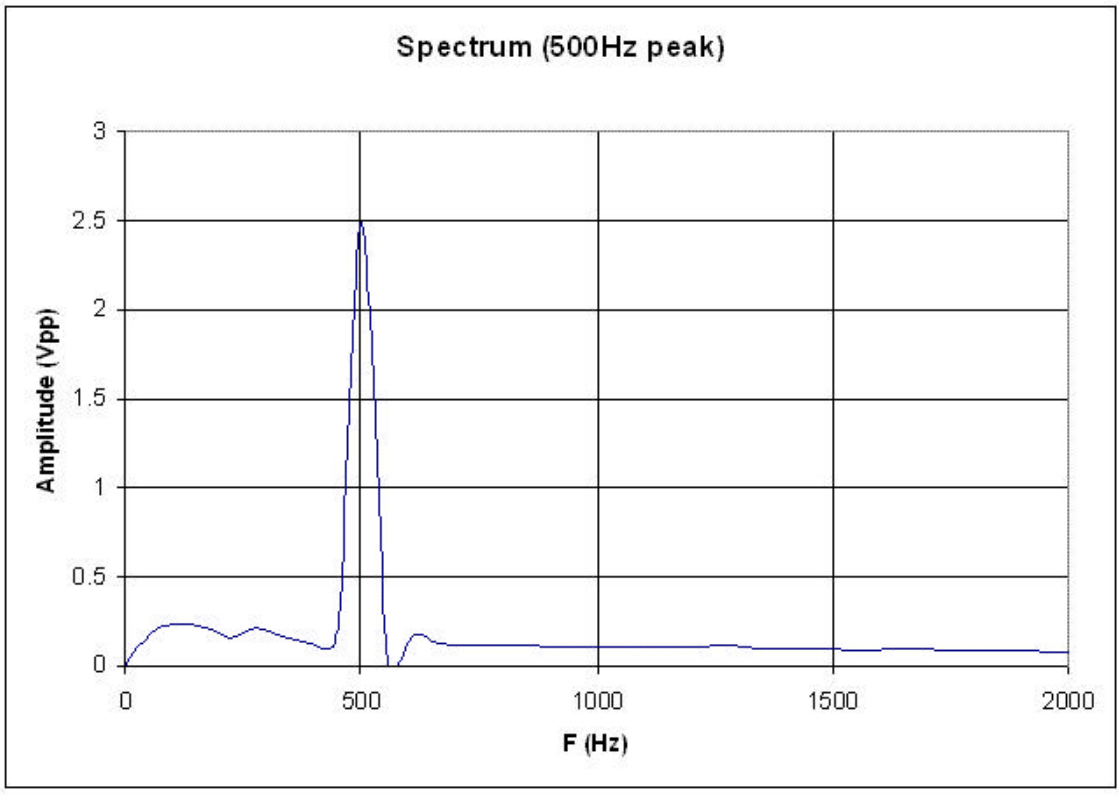
Chart 3

Chart 4

Note: the chart range is 0 -20mA



History data log (sample):



Sample signal spectrum (peak frequency, in this case about 500Hz is proportional to strip velocity)

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4. Conclusions and discussion.

The test showed that the sensor is capable of tracking the speed of the strip from about 0.7[1] through 3 m/s and beyond, providing that it is mounted within about 30cm from the strip edge to antenna output (measured along the antenna axis), and that no moving objects or obstructions are within the beam path, other than the strip edge.

The issue remains to be settled in the subsequent test whether the level of vibration is acceptable to the sensor as is, or if it may require a rubber damped mounting.

The optimum sensor configuration settings need also to be worked on, in order to make the sensor respose pre-determined during the transient events such as strip velocity zero or very low on start-up, and during strip unloading when the strip edge disappears from the beam.

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[1] The lower range is determined by the software configuration and the cut-off threshold imposed by the signal to noise. It is estimated than with a proper configuration and sensor mount, a much lower minimum velocity level can be set.