Proceedings World Geothermal Congress 2020+1
Reykjavik, Iceland, April - October 2021

# Resolving the Shifting of Pressure, Temperature and Spinner Dataset Using Geostatistical Prediction Data Methods : In case of Single Error Data Recorded Tools

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**Keywords:** Pressure, Temperature, Flow, Statistics

## ABSTRACT

The package of data recorded from routinely well measurement is Pressure, Temperature, and Spinner Measurement either Injection, Production or even Monitoring Wells. Somehow, the operation of the measurement faces several obstacles that affect the quality of recorded data.

In this case, Pressure, Temperature and Spinner measurements in Well "K" during the operation was going well, but after downloading the Log Down and Log Up dataset with speed 20, and 30 ft/min, there was a different pattern between Log Up and Log Down Data in speed 30 ft/min, through comparing all the data, it can find that the Log Up of speed 30 ft/min is an anomaly among the other data where the data was shifted lower than others. This paper will propose several geostatistical methods such as regression.

Finally, the best methods to predict and repositioned the data are regression methods with the regression coefficient 0.9. These methods could be assigned for any kind of shifting dataset with the constraint of another normal pattern of the dataset.

## 1. INTRODUCTION

Pressure-temperature-spinner (PTS) surveys are a valuable surveillance tool for determining and monitoring of subsurface conditions in geothermal wells and evaluating changes in reservoir conditions.

A spinner is an impeller that is used to measure fluid velocity and attached to the bottom of pressure-temperature downhole tools. The impeller will rotate due to fluid flow in the blade of a spinner, with the frequency being proportional to the relative velocity between the tool and fluid :

$$f = \frac{V_{tool} - V_{fluid}}{C} \quad \text{(1)}$$

Or

$$V_{fluid} = V_{tool} - C \times f \quad \text{(2)}$$

C is the pitch of the impeller in meters/cycle. V is velocity. f is frequency/ rotate per second.

Almost all downhole tools today are using electronic instruments including for pressure and temperature measurement. Although electronic instruments provide greater accuracy and frequency of measurement, electronic instruments also can still be subjected to errors associated with data recording and processing.

According to Grant & Bixley, 2018 there are some possibilities for data to become offset or shifted with respect to depth, such as:

For an electronic instrument that can record and process data with some time interval, the pressure-temperature-spinner profiles are recorded while the tool is moving (speed 15 m/min 45 m/min). This shifted depth due to moving tools doesn't happen in a mechanical downhole instrument, because the tools are recording while it is held stationary at a fixed station in the wellbore.

Thermal expansion of the wireline and liner. Due to measurement are held while the well is flowing, there are possibilities that make the wireline expanded because of the heat. The expression of the expansion is given by

$$\Delta L = \alpha L \,(T_{avg} - T_o) \quad \text{(3)}$$

α = coefficient of expansion

Tavg = average downhole temperature

To = surface temperature

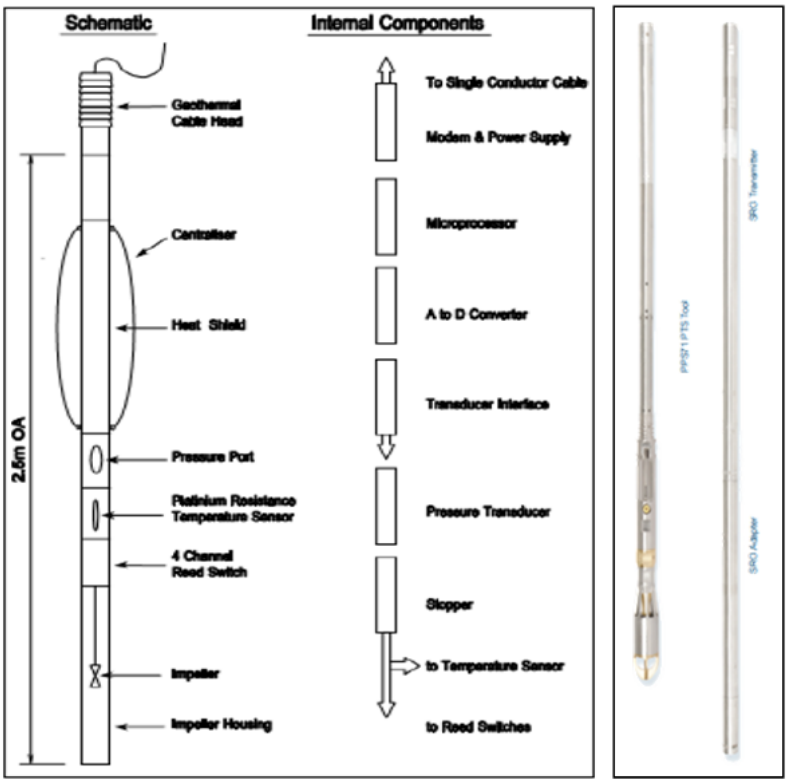
To reduce the shifting depth and referenced to a certain depth casing collar locator are included in PTS logging tools, so the log can be referenced to casing or liner connection.

Time lag between measurement and recording (downhole data and depth measurements are merged) depending on whether logging is real time or memory mode

The shifted depth can be checked by comparing data from Log Up and Log Down in the same interval.

## MATERIALS AND METHODS

**Tool components:**




Several Critical materials are :

- PTS Memory Tools
- Toolbox
- Fuel
- Tissue
- Lubricator
- Personal Protective Equipment
- Slickline Unit
- Boom Truck / Crane

**Figure 1. PTS Tool (Stevens, 2000)**

### Methods

Operation Procedures:

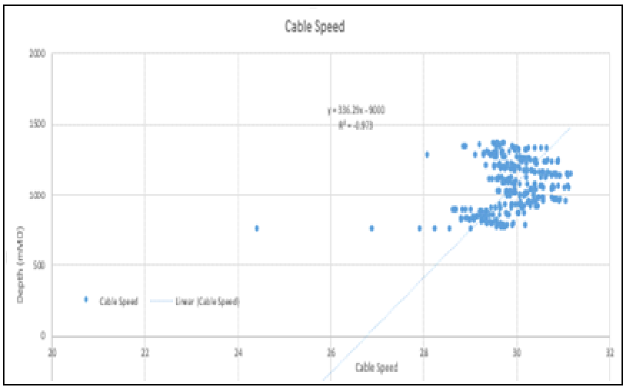
- Preparation and Measurement of Pressure, Temperature, Spinner, including rig up equipment, run in hole through log up and log down with speed:
- 20 ft/min
- 30 ft/min
- The interval survey from 753 – 2659 mMD.
- Download recorded data from PTS
- Analyze the dataset: average the value of cable speed, spinner rotation, categorize the depth, temperature and pressure.
- Apply statistical analysis to predict the shifted using regression.
- Especially linear regression

## RESULTS

The statistical methods could be applied in terms of single error data such as single error data logging down with cable speed of 30 m/min while the other data as the guidance to predict and re-positioning the error data into the proper position.

Due to the error was just found in certain depth exactly at 650 – 732 mMD, then it can resolve with comparing the suitable data value at the same depth in another cable speed data which is Log Up data with cable speed 30 m/min, Log Down 20 m/min and Log Up 20 m/min.

As the first parameter to be considered in the recorded data is cable speed data, so we need to adjust the similar and proper speed into 30 m/min as it must. The crossplot between depth of 735 – 1365 mMD applied to acquire the regression equation. Linear regression shows an equation : y = 336.29x – 9000, with y refers to depth, and x is the cable speed.



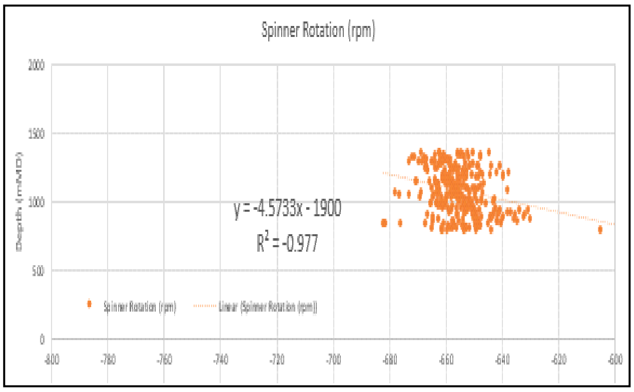




**Figure 3&4. Linear Regression methods applied to predict the values of shifted dataset.**

Depth: 753 – 1365 mMD

y = 336.29x – 9000

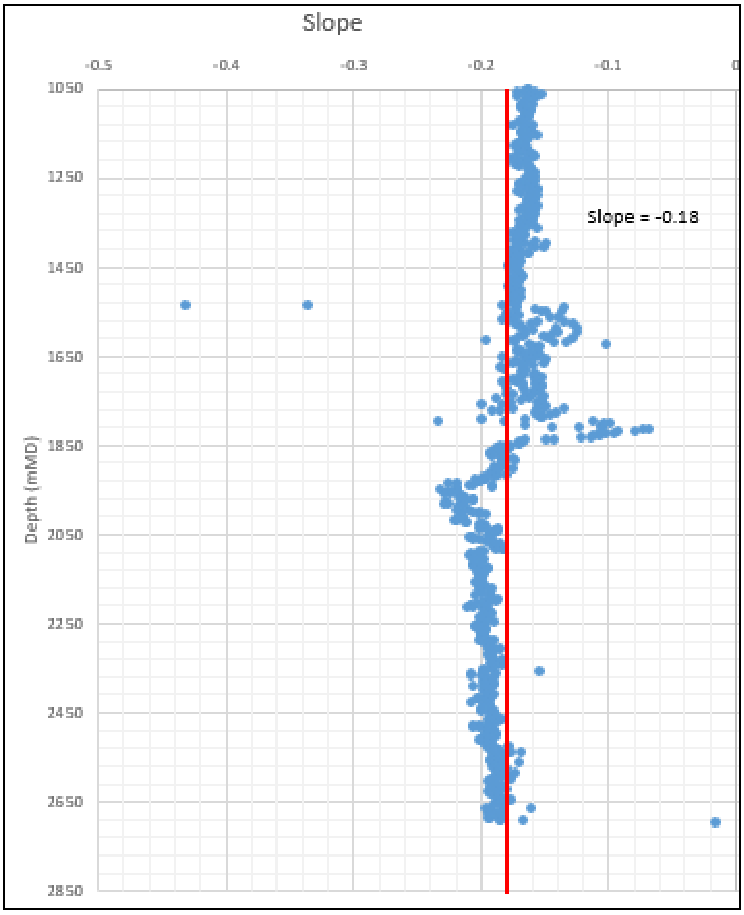
$R^2$ = -0.973

Depth: 753 – 1365 mMD

y = -4.5733x - 1900

$R^2$ = -0.977

Then, we need to assure that all the parameters to calculate mass rate at the end of PTS data analysis was matched each other's especially for all the cable speed during measurement operation. Here is the slope calculated with the formula:

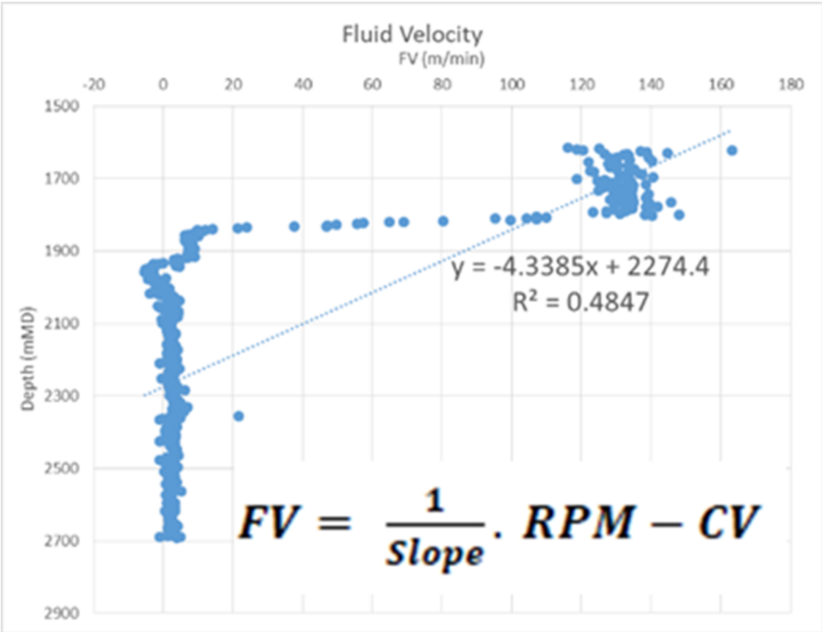



Slope = Spinner Rotation/Cable Speed

**Figure 5. Representative Slope = -0.18**

Critical parameters such as cable speed, spinner rotation and supported with slope value will be used to calculate fluid velocity. Actually, it was not necessary to use linear regression as well as speed and rotation previously, but in this case, otherwise it was calculated and there's also linear regression equation to validate and confirm the fluid velocity value of certain interval which is especially for 735 – 1365 mMD.

The regression trendline and equation of Well "K"




Depth: 753 – 1365 mMD

y = -4.3385x – 2274.4

$R^2$ = -0.4847

**Figure 6. Regression plot of Fluid Velocity**

As the final purpose of this method is to resolve the error and shifted on PTS data, so there should be a comparison between unresolved and after resolving the error data refers to the figures as follows:

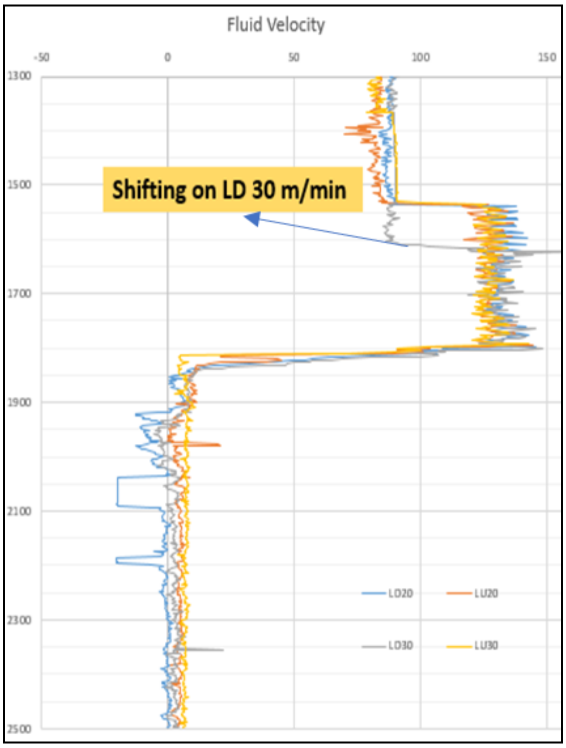



Figure 7. Shifting Data of Log Down with Speed 30 m/min

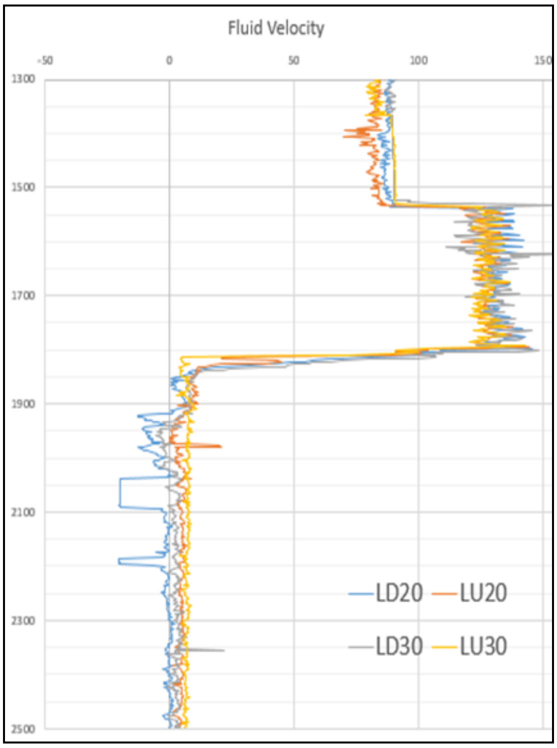



Figure 8. Resolved Data of Log Down with Speed 30 m/min

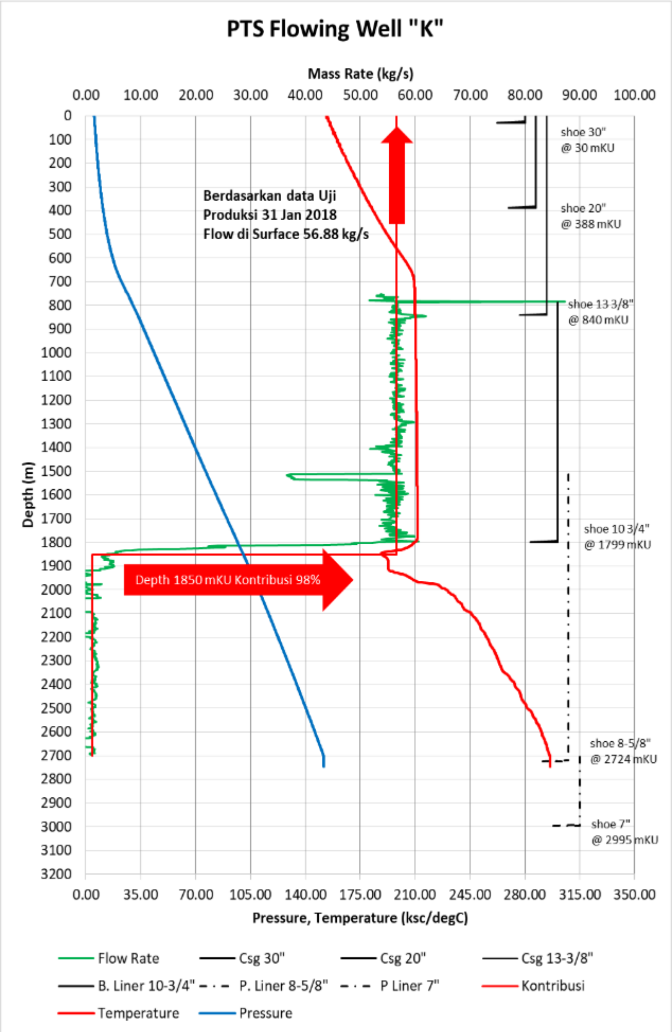



**Figure 9. PTS Flowing Survey Well-K**

PTS Data analysis:

- Production test data shows that a surface flow of 56.88 Kg / S (100% Opening)
- WHP at PTS 4.4 Kscg / Throttling 50%
- Pressure Max 151.51 Kscg @ 2700 mMD
- Temperature Max 295.87$^0$C @ 2700 mMD
- Indication of Major Feed Zone at 1850 mMD
- Sinker Bar 2" can only enter up to 2981 mMD
- PTS Tools can only enter up to 2700 mMD.

## CONCLUSSION AND RECOMMENDATION

There are some possibilities for data to become offset or shifted with respect to depth, such as:

- For electronic instrument that can record and processing data with some time interval
- Thermal expansion of the wireline and liner.
- Time lag between measurement and recording (downhole data and depth measurements are merged)
- Statistics method which used to resolve the shifted data is mostly linear regression equation.

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