Tension Control with Wireless Data Transmission for Stranders, Bunchers and Twisters

Abstract

In previous papers we talked about the advantages of measuring and controlling the material tension in wire, cable and rope manufacturing processes. We have also shown ways how to do it practically and especially how to get signals out of the rotating part of stranding machines. Special attention has been paid to how to handle the high number of channels that are possible on stranders.

This paper shows ways to extend the tension measurement and control to bunchers and twisters with their specific requirements. The later are in many cases completely different from the requirements of cage strander applications. It also presents a possible solution from FMS that fulfills all the necessary requirements.

1. Importance of tension control in wire, cable and rope making processes
   1.1. Tension indication vs closed loop tension control
2. Concept of wireless tension control in stranders
3. Applications of RTM systems in stranders
4. Limitations for applications in bunchers / twisters
5. New approach for bunchers / twisters
   5.1 Low power
   5.2 Miniaturized components
   5.3 Ease of installation
   5.4 1 or 2 channels
   5.5 System overview wireless tension control in a typical buncher or twister
   5.6 Applications of tension control in bunchers and twisters
6. The Original RTM 01/02 System for up to 32 Channels
7. Benefit of tension control solutions

1. Importance of tension control in wire, cable and rope making processes

In any wire, cable or rope making process in any process step it is mandatory to know the current material tension and also to keep it constant on the desired level. Tension level and consistency level of tension have a big influence on the quality and properties of the finished products.
1.1. Tension indication vs. closed loop tension control

Measurement and indication enables the operator to see if the machine is running with proper tension; if any adjustment is required, the machine needs to be stopped and the adjustments made to the pay-off.

With a closed-loop tension control any variations in the tension are corrected automatically and continuously by the controller.

[Fig. 1: Schematic diagram of closed loop tension control system]

2. Concept of wireless tension monitoring in stranders

Multiple loadcells and amplifiers (one per strand to be measured) are arranged on the layplate and connected via a bus system. The bus master collects all information and transmits this information of

[Fig. 2: Schematic diagram of wireless tension monitoring system]
all channels wirelessly to a PC that is installed on the static side of the machine. On the PC one can see the values of all channels of the rotating side real-time.

3. Applications of RTM Systems in Stranders

Processed material:
Multipolar electrical cables from copper strands Ø 0.5-1.0mm

System Description:
Wire tension is measured and amplified. It’s then transmitted by collector rings to the PLC which controls the spool drives. It’s a simple and efficient arrangement that allows operating with constant tension.

Technical Features:
Force range: 50-600N
Wrap angle: 30°
Rotation: 200 rpm
Load Cells: RMGZ422B

Processed material:
Steel cables Ø 30-60mm from strands Ø 4-10mm

System Description:
DRAKO traditionally uses Tension Measurement products from FMS. They decided to acquire a RTM wireless system in 2005 to reduce maintenance costs and better monitor the production quality. RTM was put into operation with the G3 strander in May 2006.

Technical Features:
Force range: 300-3000N
Wrap angle: 27°
Rotation: 180 rpm
System: RTM02, 12 channels
Load Cells: RMGZ531B
4. Limitations for applications in bunchers and twisters

A common requirement in many different applications is the overload capability of the loadcells: You have to expect overload conditions in any machine type and therefore the loadcells must be designed such that they withstand these conditions without the requirement of recalibration or the like. In comparison to stranders there seem to be less restrictions in buncher and twister applications such as no rotation with the result of not having centrifugal and coriolis forces. But there are other limitations that require a different design for the equipment than for stranders. The systems designed for stranders are designed to handle up to a high number of channels, is therefore higher in price and bigger in size, it needs some cabling, setup of a computer aso to provide best supervision capabilities to the user.

5. New approach for bunchers and twisters

As there is a lot of experience in wireless tension measurement applications in stranders (both tube and cage) it was a challenge for FMS to make this technology also available to machine builders and endusers for bunchers and twisters.

Specific requirements in buncher and twister applications are the following:

- limited space
- no centrifugal or coriolis forces
- typically 1-2 channels
- difficult to access for installation / wiring and also battery change
- vibrations

Therefore the main design targets to enable buncher and twister applications to use tension control and exchange wireless signals are the following

5.1 Low power

A key factor for tension measurement inside a B/T is power consumption, especially for those existing machines that do not provide power supply inside the bow. FMS has therefore developed a unit that consumes extremely low power. Furthermore the power supply comes from a Li-Ion rechargeable battery that represents best capacity vs volume ratio that is available currently.

5.2. Miniaturized components

Another key factor for tension measurement inside a B/T is size. To minimize space requirements of a buncher or twister they are built as compact as possible and therefore there is little space available for additional equipment. To enable machine users to retrofit tension control in existing equipment this must be designed as small as possible.
5.3. Ease of installation

As space and accessibility is very limited in these machines it is very important to limit the number of components that need to be installed and wired. To begin with loadcells: there are of loadcells available in different physical sizes and for a wide range of nominal forces. Normally it should be easier to place a loadcell in a buncher or twister than in a strander, as there are no centrifugal or coriolis force and we need to place 1 or 2 loadcells only; the loadcell and appropriate sheave can be determined in advance easily and can be delivered ready for an easy installation.

As bunchers or twisters are limited to 1 or 2 wires to be measured only there aren’t multiple amplifiers required. All electronics can all be built into on compact housing, including a rechargeable battery if required. The only cabling then is a connection between loadcell and electronic unit (amplifier/transmitter). If 24V DC is available within the machine one can connect the 24V and not use the rechargeable battery.

5.4. Number of channels

Where in stranders the number of channels is typically from 6 up to 32 or even 48 or 64, in buncher and twister applications normally 1 or 2 channels are enough. This helps to design compact, low-power concepts that can not necessarily be used for the multi-channel applications in stranders.

5.5 System overview of wireless tension control in a typical buncher or twister

![Diagram](image)

*Fig. 5: Block diagram and required components for a wireless transmitter system*
The measuring part consists of the appropriate loadcells to physically measure the tension and electronics that combines the functions of

- Power supply/management
- Signal conditioning
- Wireless data exchange in the 2.4GHz band

FMS components to build a wireless tension monitoring system:

*Fig. 6: Force Measuring Rollers: RMGZ100B RMGZ300, RMGZ400/600/800*

*Fig. 7: RTM X2 Transmitter and Receiver: EMGZ482T and EMGZ482R
RTM X2 Battery pack (6.7Ah) and Charger*

With the FMS RTM X2 system one only needs 1 or 2 loadcells and a transmitter unit (that already contains a rechargeable battery for up to 150 hours running time), 1 or 2 cables to connect the loadcells to the transmitter. This is it on the machine side. On the static side only 1 electronic unit is required. This unit needs to be powered with 24V DC and can already display the tension values on a
bar-graph display. It also provides 0...10V or 0/4...20mA analog outputs to connect this the tension information to a PLC for example.

Fig. 8: System Demonstration of the Wireless Tension Monitoring System RTM X2 from FMS
5.6. Applications in Bunchers and Twisters

Processed material:
Copper Wire

System Description:
Wire tension is measured with Force Measuring Roller and amplified with an analogue amplifier. It’s then transmitted by collector rings to the PLC which controls the drive.

Technical Features:
- Force range: 300N
- Wrap angle: 90°
- Rotation: 350 rpm
- Load Cells: RMGZ425A
- Amplifier: EMGZ306A

8. The Original RTM 01/02 System for up to 32 Channels

In contrast to the 2-channel RTM X2 system for bunchers and twisters the RTM 01/02 was the first radio transmitted system in the world designed specifically for large cage and tubular stranding machines. The system is utilizing an industrial PC as a control and processing unit. The amplifiers or controllers can be parameterized from the PC. Control parameters can be adjusted from the PC while the machine is running. The system can be set-up to provide a warning signal or output or stop the machine immediately in case of a wire break.
Features of RTM 01/02:

- Wireless, interference-free transfer of measurement signals for up to 32 channels
- Data transmission via Bluetooth wireless standard
- Precise, consistent monitoring of all tension data relevant to production
- Visualization and synchronization of tension data to the product by running length
- Sophisticated software for tension data analysis (incl: limit violations, alarms, quality reports)

![Multi-Channel RTM 01/02 System specially suited for cage stranding machines with up to 32 channels](image)

6. Benefits of tension control

Variations in tension are responsible for a variety of defects in different types of materials:

- Ropes that aren’t straight because of uneven tension in different strands
- Ropes that are used as load cable in elevators, cranes, cable cars and such do not reach their maximum strength because not all strands are under the same tension and therefore the load is not distributed evenly amongst all strands
- Electrical properties cannot be maintained: resistance, cross-talk, impedance between 2 conductors is not consistent

The new system RTM X2 for bunchers and twisters has been prepared to interface a tension controller or a PLC leveraging all the benefits of a controlled tension. An increase of machine productivity yields to faster return on investment. The RTM system can pay for itself typically in less than one year by reducing material breaks and eliminating overstressing and excessive slack in wires and cables. Therefore overall finished product throughput is increased. The RTM System also improves the overall quality of the products produced and can open a wire and cable manufacturer up to new markets that demand documented and verifiable manufacturing condition products. Many RTM systems are currently in operation throughout the world.

You will see a better future with FMS tension control!