FRICTION COMPENSATION FOR THREAD LENGTH MEASURING SYSTEM USING DISTURBANCE OBSERVER

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ABSTRACT

In textile industry, there are many types of length measuring systems for thread, but it can be seen that they cease to produce accurate results after working some time. Wheel and encoder assembly can be introduced to a current system in order to measure thread length irrespective of the bobbin or thread type, but the additional tension produced by the wheel can lead to some unwanted results like breakage of thread or high level of tension of the wounded thread on the bobbin. This research presents a system that can compensate the additional tension generated by the wheel and encoder assembly, using a dc motor in the dynamic conditions. The concept of disturbance observer is used in order to sense and compensate the additional tension on the thread created by the friction of the encoder wheel.

***Key words*:** Disturbance observer, Friction compensation, Motion control, Thread length measurement, Textile industry.

1. INTRODUCTION

It is a necessary requirement to measure the length of sewing thread when it is wounded on bobbins. In general, this is carried out by winding a larger cone first and then winds small cones using the larger ones that have already been wounded. In the former case, the thread length is taken as an approximate measure with the diameter increment of the bobbin, whereas in the latter case the length measurement must be an exact length. But in most of the length measuring systems, these lengths get varied by some amount up to 1% to 2% from the set length. The reason for this variation is the complex calculation method used in the machines to get the thread length. This method takes the speed of the bobbin, pitch of the thread and the diameter of the cone as input parameters. This is one of the simplest methods used in the textile industry to calculate the length of threads. But the problem of using this method is the requirement of knowing the thread diameter before the procedure as the diameter is an input parameter of this method. Therefore in each and every time the thread type is changed, these parameters must be changed accordingly which has been identified as a drawback in this method.

There is other non-contact methods are available such as charge counting mechanisms with injects charges to the thread at a point and count them at another point. These measuring devises are externally fixed to the existing machineries and they cost so much.

In contrast it is also possible to use a contact method to calculate the length such as using a pulley with an encoder assembly for the same purpose. But most of the thread manufacturers refuse to use this method as the pulley and the encoder assembly exerts an additional tension on the thread when it is wounded. Although this external tension is not sufficient to break the thread while the thread is wounded even at higher speeds as 1000 meters per minute, this tension is sufficient to deform the bobbin. Also it changes the pitch and the spacing of the thread in advance which leads to lose the quality of the final cone.

This paper presents an extension to the latter described method which can be used to measure any kind of thread even without knowing the thread properties such as the thread diameter. The method used here is simply giving a support to the fast moving thread by using a DC motor.

Pulley which is in contact with the thread is directly coupled to a DC motor with an encoder assembly. The controller of the system takes the encoder output and the motor current as the inputs to sense the speed at which the pulley rotates. The idea behind this method is the rotating of the pulley at the same speed at which the thread moves. By doing so it is expected to let the thread feel that there is no pulley is in contact with the thread to exert an additional tension on the thread.

The control system used here is based on the concepts of "Disturbance Observer".