MECHATRONIC DAMPING FOR CONTACT ROLLS IN FILM WINDERS

by

Bernd Sieber
Brückner Maschinenbau GmbH & Co. KG
GERMANY

ABSTRACT

The winding of a web is one of the most extensive and error-prone processes in web handling. All known solutions are limited in the range of properties and production parameters. To broaden the mentioned limits, a new mechatronic system for the feeding drive of the contact roll has been developed. A comprehensive simulation with several models has shown the behavior of the new system. The model considers in the final state the elasticity and mass of all relevant elements. The main functions of the feeding drive operating the contact roll for positioning, pressing against the winding roll and for the active damping have been modeled. The simulation has revealed the avoidance of backlash in the feeding drive as the most important factor for the winding result. The second important factor is the damping of the contact roll.

The principle of the new system involves the application of an electric linear motor for the feeding. This drive is free of backlash. The linear drive as a part of the control loop is featured by a simple remote control according to the most relevant parameters in the winding process – the nip pressure and the damping of the vibrations excited by the rotating winding. A test stand consisting of the components of a real feeding drive assembly was built to verify the simulation results. The test results confirmed the simulation results. The results in industrial applications have shown the congruence with the results of both the simulation and the test bed.

The new drive has been introduced in film stretching lines. The results in industrial applications have shown the congruence with the results of both the simulation and the test bed. Especially the remote control of the contact force and the damping are the most important features. The quality of the wound roll has been improved significantly.

NOMENCLATURE

A_d	center distance mill roll to contact roll
B_L	damping constant linear drive
R_W	radius wound roll without deformation
R_{CW}	radius contact roll without deformation

Δx	displacement
C_{CW}	spring constant of contact roll and wound roll
C_W	spring constant of mill roll and bearing
C_S	spring constant of slider
C_P	spring constant C-frame
M_W	mass of mill roll and wound roll
M_{CW}	mass contact roll
M_S	mass of slider (incl. primary of linear motor)
M_P	mass of C-frame
F_{MOT}	force of linear motor (pressure + damping)
F_{EXC}	force of excitation
F_d	damping force of linear drive
$Force\_set$	set point force (pressure)
x_act	actual position
x_W	displacement wound roll
x_{CW}	displacement contact roll
x_S	displacement slider
x_P	displacement C-frame
I	electric current
$delv$	Speed difference in general
$diff\_speed$	Speed difference without continuous part
$speed\_act$	actual speed
b_W	damping constant of mill roll and bearing
b_{CW}	damping constant contact roll and wound roll
b_S	damping constant of slider
b_P	damping constant of C-frame

TRENDS TO IMPROVE THE PERFORMANCE OF FILM STRETCHING LINES

The range of features of plastic films spreads more and more related to both the dimensions of the film and the stretched materials. Nowadays the most stretched materials are PP (polypropylene), PET (polyethylene terephtalate) and PA (polyamide). The current dimensions of the end films to handle in the winding process have a width up to 10 m and the thickness is in the range from 1 µm to 350 µm. The speed of the end film is reaches to 550 mpm. In the future the speed will increase in general. That means the maximum speed will increase and the level of speed especially in field of special products as well. Special products often outputs at lower speed. In general the width of the end film will increase also.

The winder has to achieve the requirements by increasing performance of the end films. Cool describes comprehensively in [8] the winding defects and the reasons for them citing an extensive literature. The equations given in that paper reflect the relations in the winding process and in the wound roll. The determination of the parameters in the mentioned equations requires time consuming tests with exactly defined constraints. Furthermore a small change in the elementary features of the film, e.g. the modulus of elasticity (it can change locally or timely during the winding process by the variation of the stretching parameters) could impede the conditions for the winding and could result in a discontenting quality of the wound roll. Consequently, in most cases such parameters cannot be determined during the manufacturing process or afterwards, i.e. in the wound roll. The operator of the stretching line (including the winding process) has to fulfill the operation manual for the manufacturing process. That and his experience make it difficult for him to turn the knobs for optimization of the winding process, as accurately described by Roisum [2].

DEFINITION OF REQUIREMENTS TO WINDING PROCESS

This paper considers only center winders with a contact roll. A simple but difficult requirement is to achieve to solve the dilemma described above: "The winder has to perform a wide range of parameters however without the deterioration of the film quality." In the industrial process the most important functional requirements for the contact roll are:

- The contact roll has to touch the winding roll as an ideal line with constant pressure over the whole length and during the whole winding.
- That means in detail the functionalities for the feeding drive of the contact roll:
- Building the force for correct radial pressure
- Damping of vibrations
- Moving back the contact roll from the center of the winding roll with its increasing radius
- Moving the contact roll towards to the new mill roll after finishing the winding

STATE- OF- THE- ART

It is difficult to classify the variety of solutions for the feeding drive found in a long time of development but the most applied principles are:

- Building the nip pressure by pneumatic or hydraulic cylinders or by a combination of screw spindles and springs
- The damping does function by separate cylinders or is integrated in the pressure building cylinders
- The device building the nip pressure refeeds the contact roll after finishing the winding

All of that devices show more or less back lash and it increases by wear. The effect of damping is often not remote controlled. The functionality is mostly split to several components. The leakage in the hydraulics contaminates the environment and the film.

CONCEPT FOR THE NEW SOLUTION

The basic idea is the application of a linear drive. The experience in the field of linear drive drives in simultaneous stretching lines for plastic films [3],[4] has encouraged that application. In that paper the linear motor is defined as a synchronous type excited by permanent magnets. The permanent magnets are assembled in the secondary part of the linear motor – short the secondary. The secondary and the primary are separated by an air gap of about 1 to 3 mm. The interaction of the currents in the primary and the magnetic flux of the secondary generates forces without any contact in between both parts (see Figure 1). Both, the secondary or the primary can be assembled as moving part of the linear motor. Worthwhile is the fixed primary and the moveable secondary to save flexible cables. From the mechanical point of view the linear motor acts as a pure force transmission. The currents fed by the inverter determine the force (see the right part of Figure 1with the currents $I_3 > I_2 > I_1$). The speed of the movement follows the frequency of the currents. The combination of the serial products - the linear motor, the inverter and the linear encoder – results in a new quality [6]. That solution unites all above mentioned functionalities.

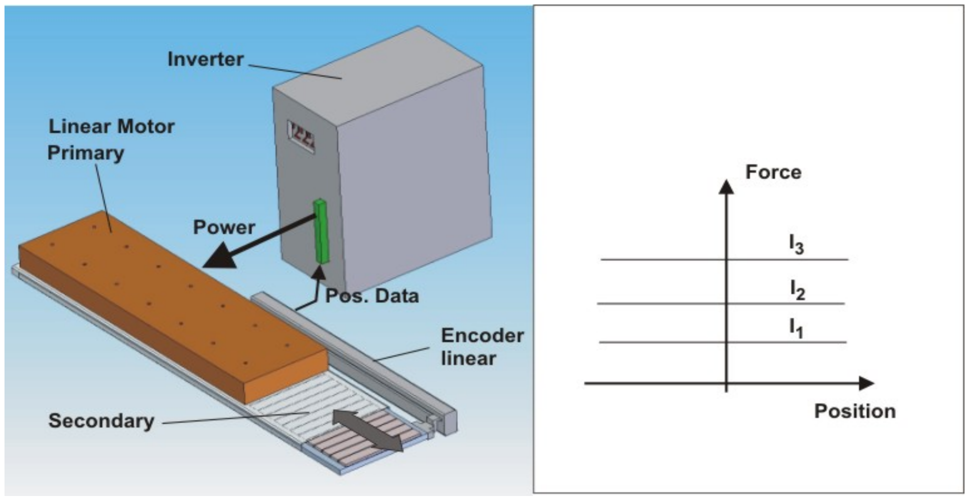


Figure1: Components of the linear drive (left) and the force characteristic (right)

One linear drive is assembled at each end of the contact roll, as shown in Figure 2. The C-frame suspends the drive. A look at the control circuit in Figure 3 helps to explain the mode of operation. The pressure is given by the set point *Force_set*. The force controller calculates the currents proportional to the *Force_set* and the inverter feds this currents to the linear motor. The chosen value of the pressure maintains independently from the position of the contact roll. Certainly the value of *Force_set* is freely adjustable at any time to follow the required characteristic. Irregularities as deviations of the real surface of the winding roll from the ideal cylinder or variation of the elasticity of the winding roll cause movement in the contact roll. The encoder measures the movement and the derivation of the position gives the actual speed of the movement. The element "suppression continuous part" eliminates a constant speed (movement caused by increasing radius of the winding roll). The speed difference *diff_speed* is compared with the set point *speed = 0* the speed controller "speed control" calculates an additional force – equivalent to the *diff_speed*. This force is superposed the *Force_set*. The speed control acts as an electronic damping, see equation {1}.

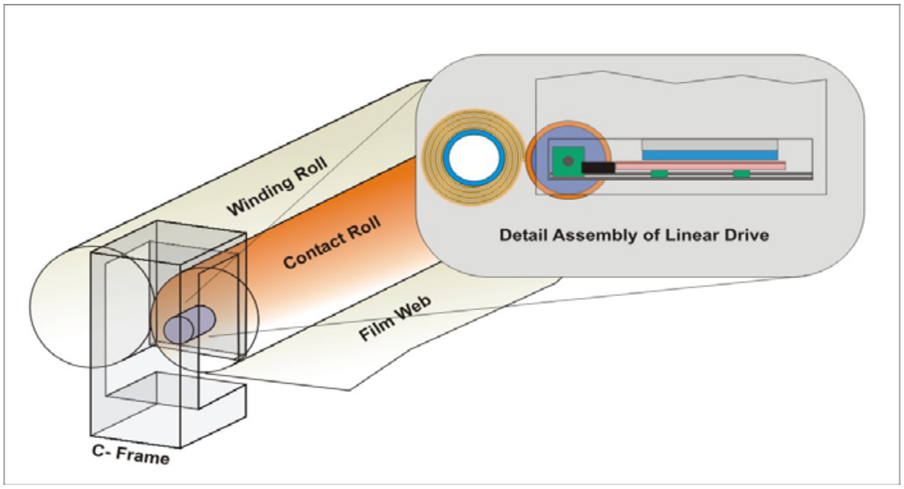


Figure 2: Principle of the assembly of the linear drive in the winder

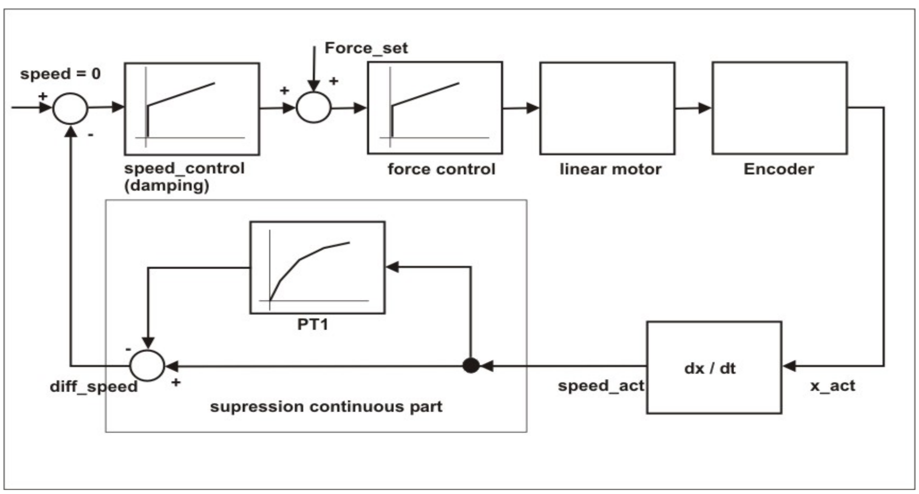


Figure 3: Control circuit

$$F_d = B_L * delv \qquad \{1\}$$

The damping constant B_L is easy adjustable by the gain of the speed controller.

MODELING AND SIMULATION

The new solution seems to be very simple but here are two basic questions to answer by modeling and simulation:

- Are the separate linear drives at each shaft of the contact roll able to influence the behavior of touching line in between contact roll and the winding roll (especially the ideal contact line)?
- Are the linear drives able to suppress effectively the oscillating systems?

The modeling has been succeeded step by step. The overall layout in Figure 2 shows the systems able to oscillate – the C-frame, the winding roll and the contact roll. Nowadays it is not so difficult to model the mentioned systems in a FEM- tool in spite of their complex configuration because their intrinsic features and geometries are well known. The eigenfrequencies and eigen values of the separate parts have been determined by FEM. The winding roll changes the mass, the intrinsic damping and the stiffness during the winding time and different materials cause different behavior. In literature there are only a few trials to describe the winding roll related to its influence to the oscillating behavior. The coupling of the influencing vice versa systems in a FEM requires enormous resources and the interpretation of the simulation results is often not so demonstrative. The transformation of the FEM results in videos or in 3D- diagrams is time consuming. For easier description of the behavior another method was chosen. The principle of the modeling is described comprehensively in [7] and it is compactly mentioned here.

Modeling

From the origin FEM models of the contact roll and the mill roll with thousands of nodes have been derived the reduced model with about 50 nodes. The reduced model of the contact roll (shown in Figure 4) reacts at the nodes in the same way as the complete FEM model. The force of linear motors is directed only in the Z- co-ordinate and because of that all the evaluation considers only the Z- co-ordinate. The reduced models of the contact roll and the mill roll are transferred to simulation software [10]. Lengthwise the nodes of the contact line of the reduced models are coupled by discrete springs modeling the elasticity. The models start with approximate values to bridge problems by the absence of exactly determined values for the radial elasticity and damping factor for the wide range of wound film. The stress-strain- curves from the stack tests results for PET, described in [12] Figure 2, deliver an approximate for the elasticity.

For the PET wound roll shows Figure 10 in [11] the radial stress versus the diameter. From the outer layers of the wound roll the stress increases in direction to the mill roll from zero to a constant value and growth near the surface of the mill roll. The spring modeling the film in the wound roll has no mass and varies dependently with the radius of the winding roll. The approximation should be acceptable for the evaluation of the dynamics. By the variation of the values in the simulation a wide range of parameters is covered. In this way different materials or non linearity are considerable by look-up-tables.

The damping of the wound roll is unknown and difficult to determine as generally valid value as mentioned also in [9] for paper. Discrete viscous damping elements in parallel to the springs consider the damping of the wound film. As described for the springs a wide range of damping values covers the different materials. The C-frame is modeled by one spring and in parallel one viscous damper element their values present the first eigenfrequency of the C-frame in the Z-co-ordinate. The linear motors effect as a force in combination with the control circuit (see Figure 3).

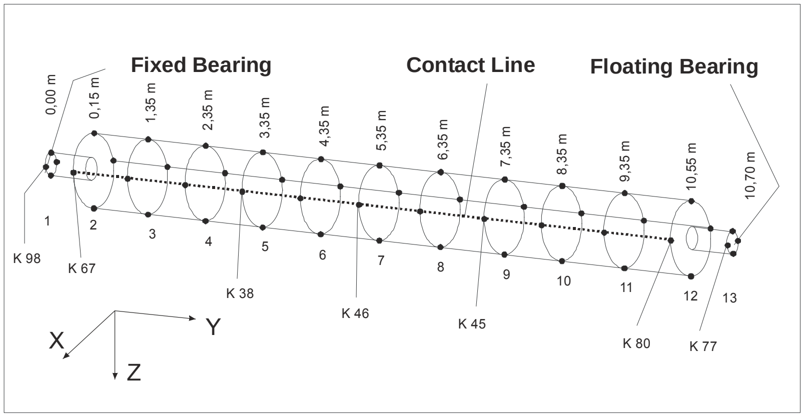


Figure 4: Reduced model of contact roll and co-ordinates

The resulting simulation model shown in Figure 5 is a dynamic model running all over the time of winding. The mass of the winding roll increases by the amount of wound in film. The increasing mass changes the eigenfrequency of the winding roll but the change in stiffness is neglected. Because of that the resultant eigenfrequencies are lower than the real one. No dynamic effects appear if radius of the winding roll keeps constant at all nodes. The system is excited by a force in the middle of the contact roll. The shape, the magnitude and the frequency of the force are freely adjustable. So far the principle of the modeling is described in brief.

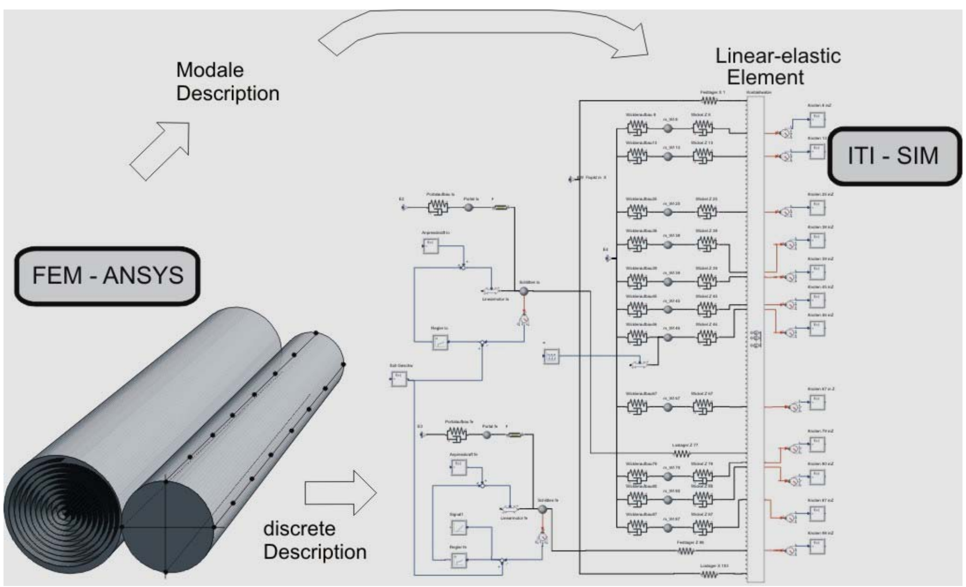


Figure 5: Principle of modeling (here is only modeled the contact roll by the linear elastic element)

Simulation

The results of the simulation are the displacements of the nodes and thereof the bending line of the rolls and the deformation of the hollow roll are derivable. Furthermore the forces and the momentums (displacement, speed and acceleration) are visible at all nodes and inside the elements. Their frequency spectra of magnitudes or transfer functions are monitored in an easy way of pressing a button in the simulation software. The response of the model at different exciting time functions, i. e. noise or periodic shapes as sine wave, rectangle or triangle or single impacts as jump step or Dirac pulse, has been studied. As the most appropriate one has found the sine wave with band limited sliding frequency or with a couple of sine waves with different frequencies.

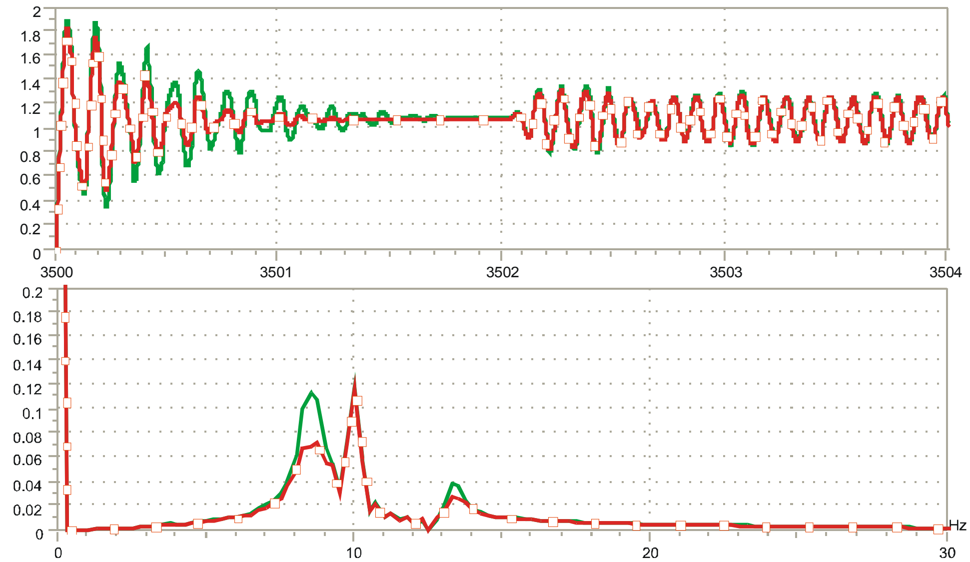
Some samples shall demonstrate the main results of the extensive simulation. The simulation has spanned a range from 10 Hz to 100 Hz and forces from 100 Hz to 10000 N. The Figure 6 shows the results at the shaft of the contact roll by applying the data in Table 1. The displacement is the difference defined by equation {2}

$$\Delta x = (R_W + R_{CW}) - A_d = 0 \qquad \text{touching}$$

$$\Delta x = (R_W + R_{CW}) - A_d < 0 \qquad \text{bouncing} \qquad \{2\}$$

$$\Delta x = (R_W + R_{CW}) - A_d > 0 \qquad \text{pressure}$$

The Figure 7 depicts the geometry and the direction of displacement. The sinusoidal force excites in the middle of the contact roll. At the time 3500 s, i.e. the half of the final winding diameter, the continuous pressing force increases from 0 N to the value in Table 1. The active damping is active. The higher the damping constant the faster the initial oscillations fade away. At the time 3502 s the excitation starts. The frequency analysis considers the time from 3500 s to 3504 s. The dominant magnitudes in the frequency range are at the exciting frequency 10 Hz and the frequencies about 8.5 Hz (approximately the eigenfrequency of wound roll) and 13.5 Hz (approximately the eigenfrequency of contact roll). The exact association of the dominant magnitudes with the eigenfrequencies of the model parts is not possible because by the coupling of the elements all of them interact and the eigenfrequencies are shifted. As expected the Figure 6 shows the lower magnitudes at higher damping factor. But it is obvious also – the higher magnitude of the excitation causes higher residual magnitudes. In Figure 6b) causes the excitation the displacement $\Delta x < 0$ that means the contact roll lost the contact to the winding roll. And the related frequency spectrum shows a wider range. That case is to avoid at operation conditions. The simulation can avoid the loss of contact by increasing the damping factor. Under real operation conditions an amount of air would be entrapped and roll defects could appear. A backlash in the drive train causes the same consequences. The negative influence of backlash per example the speed of the film is described in [1]. The conclusions are valid for the system evaluated here. It should be emphasized – the presented new system has no back lash and because of that the stable operation range is spread.



a)

b)

Figure 6: Response of the contact roll in case of exciting in the middle of the roll, magnitudes of displacement at the shaft of the contact roll versus time and frequency, all values in mm

Figure	Bouncing	Force Pressure	Damping Linear Drive	Excitation force	Frequency
a) marked	no	3000 N	5000 Ns/m	1000 N	10 Hz
a) solid	no	3000 N	2500 Ns/m	1000 N	10 Hz
b) marked	yes	3000 N	5000 Ns/m	6000 N	10 Hz
a) solid	yes	3000 N	2500 Ns/m	6000 N	10 Hz

Table 1: Applied values for simulation model (results see Figure 6)

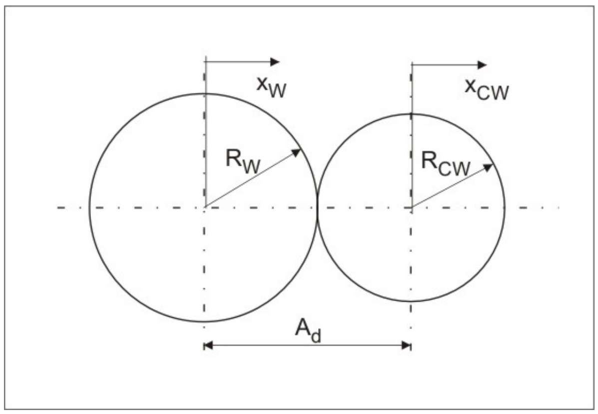


Figure 7: Geometry of winding roll and contact roll

Another result of the simulation besides the dynamics is the computation of the bending lines. A typical characteristic of the static displacement at the nodes of the contact roll and the mill roll at the contact line shows Figure 8. The displacement means here the difference unloaded roll to pressed state (both rolls are coupled by the elasticity of the wound roll). The wound roll compensates the differences in between the displacements of both rolls. The unusual bending line of the contact roll results from its special inner "low bending" design.

The next important of the dynamic simulation is: the nodes of the contact roll oscillate with the same phase. The answers to the above posed questions are as the result of the simulation:

- The linear drives at both ends of the contact roll ensure the contact between contact roll and winding roll in a wide range of exiting disturbances.
- The linear drives are able to effectively suppress the oscillations.

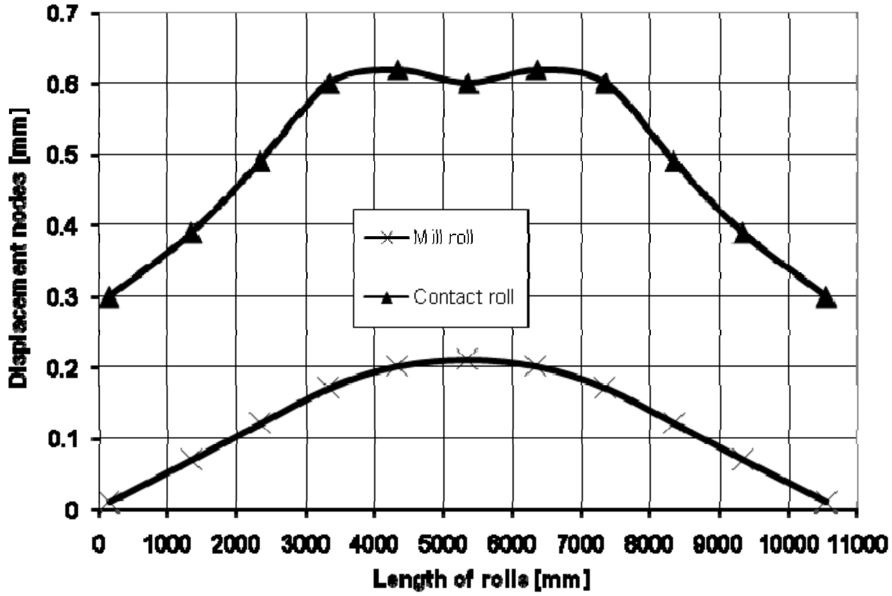


Figure 8: Static displacement of nodes in the rolls model (the sign of the displacements is contrariwise to the definition in Figure 7)

The same phase of the nodes let to ease the model by substituting the modal elements by discrete elements. The Figure 9 shows the simplified model also used in a similar form in [13]. The differential equations built for that model can be applied in common tools for simulation. But the tool [10] has been applied again. A specialty in the model (Figure 9) is the coupling of the masses M_P and M_S by the motor force F_{MOT} (the sum of the constant pressing force and the dynamic damping force). Important for the dynamics is only the damping force. The mass M_S, the stiffness C_S and the damping b_S model the secondary of the linear motor and the bearing of the contact roll. By means of the simplified model the requirements to the linear drive have found in the simulation and the arrangement of a test stand has been prepared.

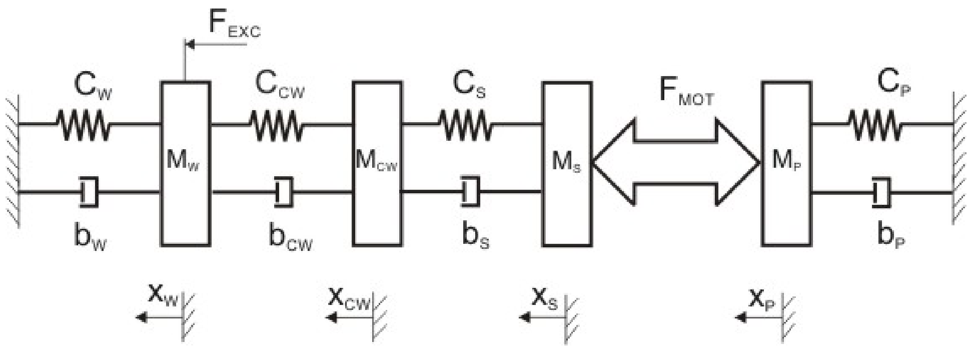


Figure 9: Simplified model of assembly

TESTSTAND

The simulation has shown that the requirements in a real winder could be met by the new system and a test stand should verify the simulation by the application of the future industrial serial components. The transfer of the elements in the reality to the test stand shows Figure 10. Comparing with the model in Figure 9 the further simplification is obvious. The simulation has shown that the stiffness C_S is much higher than the other one and it could be neglected without a loss of accuracy. An advantage of the test stand is its flexible adaption to different operation modes.

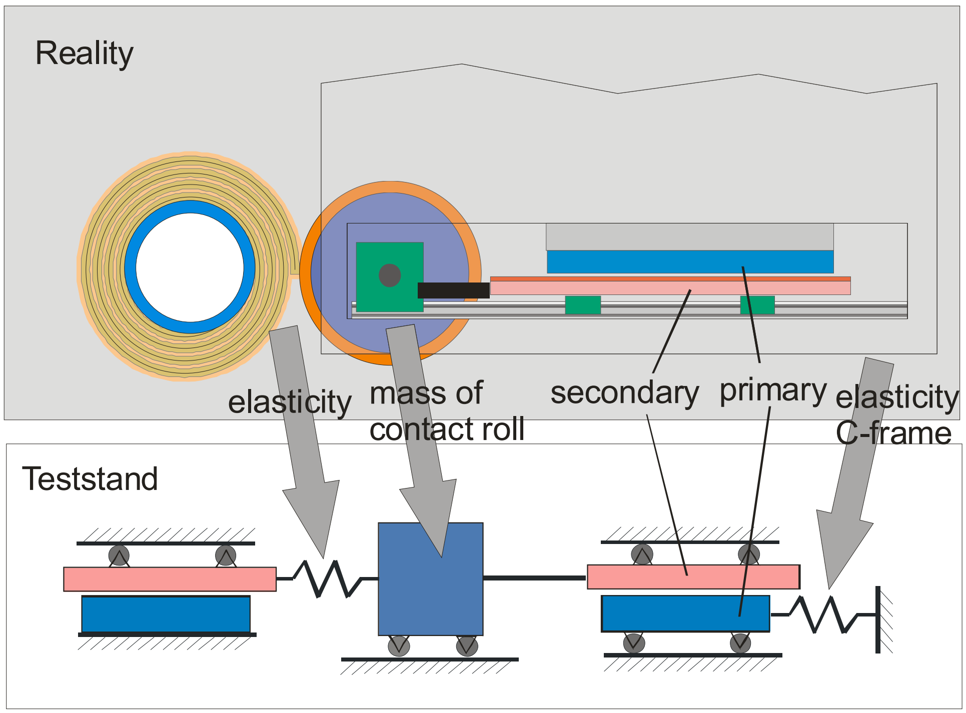


Figure 10: Transformation from the reality to the test stand

The linear motors can operate as exciter or damper only by parameterization of the inverters. The stiffness of the springs can vary by substituting them and the mass of the contact roll is variable by the number of iron plates. Different control circuits are applied in the inverters.

But there are compromises also – the big mass of the C-frame could not be realized. The stiffness of the springs has been adopted for lower than the real eigenfrequencies but for a maximum of displacement. The springs are pre-stressed to eliminate backlash. Figure 11 reflects to a greater extent the assembly rather than photos.

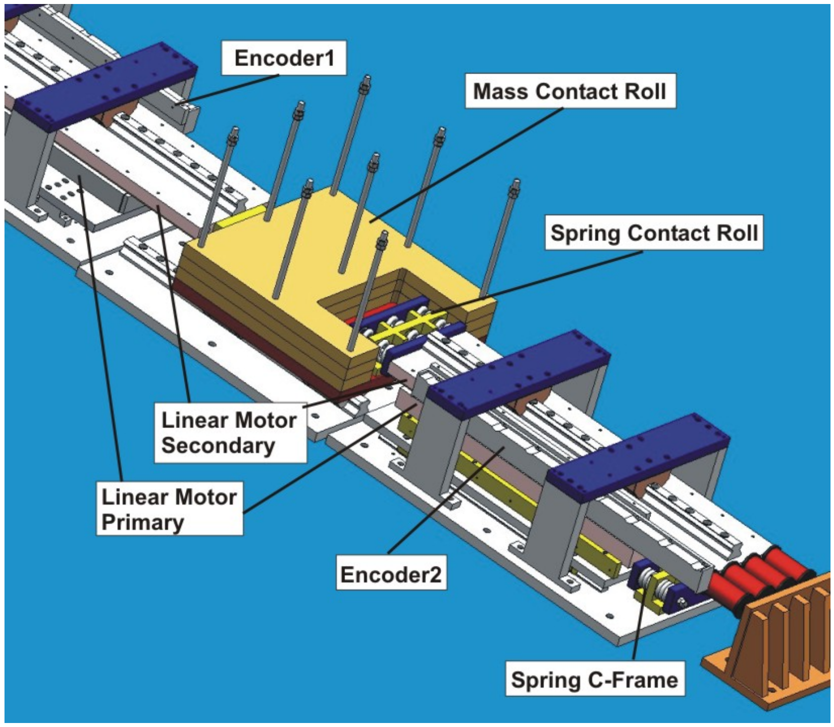


Figure 11: Components of the test stand

Figure 12 shows clearly the effect of the active damping. One linear motor excites the oscillator contenting the spring and the mass of contact roll nearby the resonant frequency (about 8 Hz). Although the low exciting magnitude of 0.3 mm the contact roll oscillates with 1 mm. By switching on the active damping suppresses the magnitude of the contact roll to an amount lower the excitation. The spring compensates the difference between the exciting magnitude and the magnitude of the contact roll.

All test results have confirmed the simulation results. In the assembly chosen for industrial application the linear encoder measures the difference of the primary's and secondary's displacements. The inverter calculates the difference speed of both parts by the resultant displacement. Despite of the chosen smoother spring than the one used in reality and the resultant wider spring travel the system operates with stability.

APPLICATION IN A FILM STRETCHING LINE

The new system has been introduced in industrial application for the first time upgrading a running line with a 10 m wide end film and speed on winder up to 500 mpm. The small space for the assembly required the moveable primary and the fixed at C-frame secondary. Figure 13 shows the arrangement. Directly after the commissioning the trial run with film began without any setbacks. For studying the behavior by disturbances a stack of film was stuck at the surface of the mill roll. The stack rotating with the mill roll causes at every revolution a bump influencing the contact roll pressed against the mill roll. Figure 14 shows the measured values compared with the simulation done by the easy model in Figure 9. In view of the simple model there is a satisfying congruence.

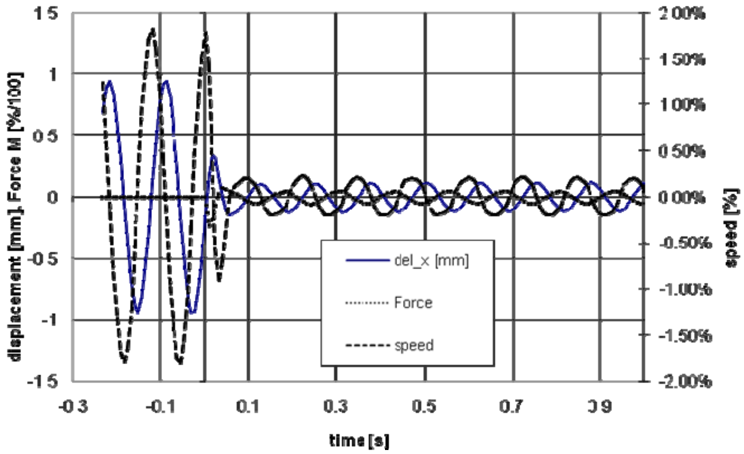


Figure12: Effect of active damping at test bed. Excitation: Magnitude 0.3 mm, Frequ. = 7.95 Hz. At time = 0 active damping switched ON. Scaling: speed 1.75 % = 45.3 mm/s, force 9.6 % = 250 N

Not all of the comprehensive studies have been mentioned here but it should be noted that the influence of the film upstream the winder to the dynamics at the winder has been evaluated. But the influence to the themes described here was low. For the quality of the wound roll the tension of the film is evident. The combination of the new solution described here and the tension control, Oedl [5], widens the stable operation range of film stretching lines.

Since introducing the first application of the new system with active damping a couple of winders are equipped by the linear drives with satisfying results.

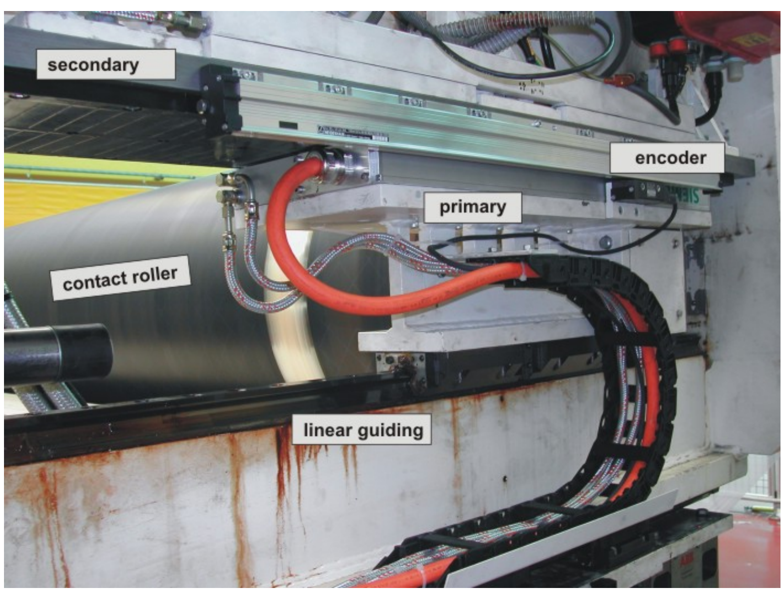


Figure 13: Linear drive in the film stretching line

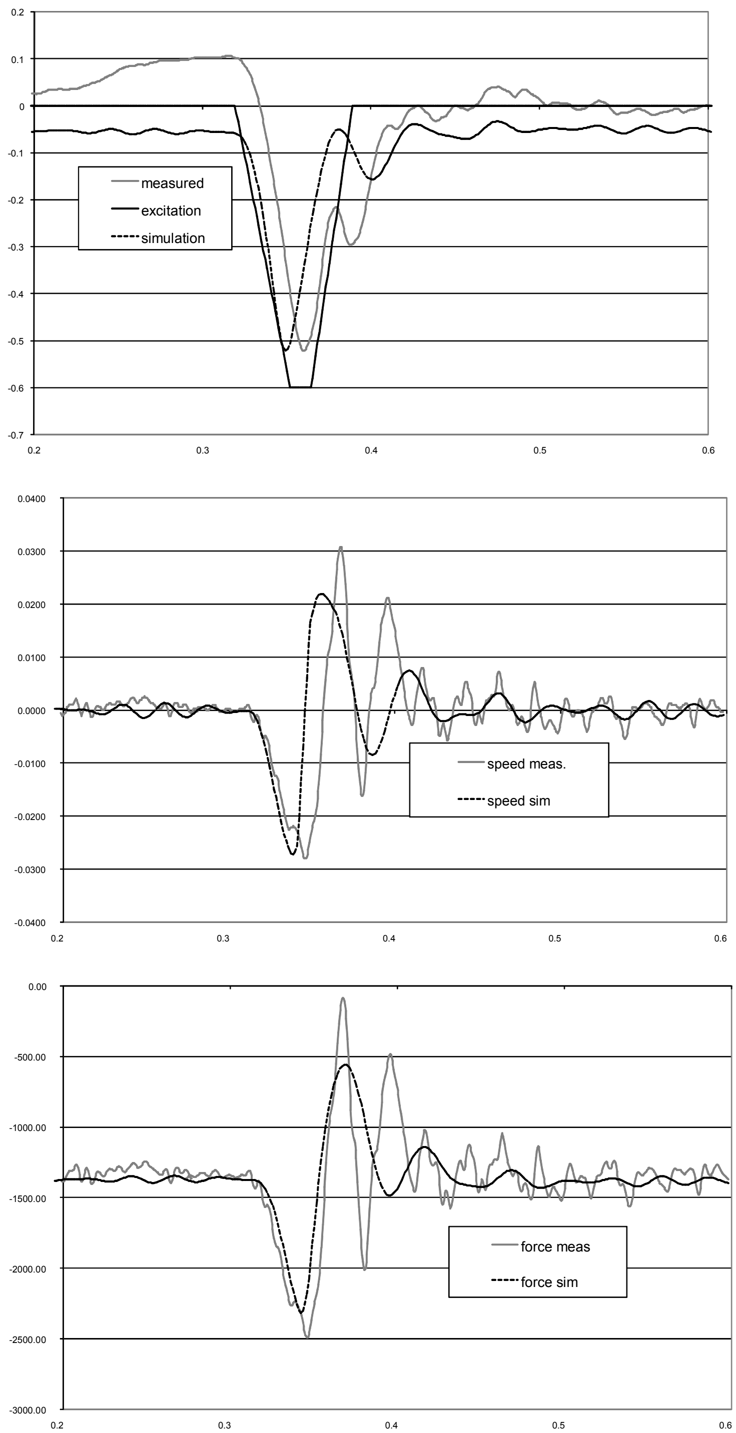


Figure 14: Behavior in case of disturbance caused by film stack at mill roll, in the top displacement in mm, in the middle speed in m/s and bottom force in N (all vs. time in s)

SUMMARY

Beginning with a comprehensive simulation the features of a new mechatronic solution for the feeding drive of a contact roll in film winders has been described. Measurements at a test bed and at an industrial application have confirmed the forecast. The advantages of the new feeding drive are summarized in brief:

- The value of the damping is simply and continuously adjustable by remote control.
- The value of contact pressure is simply and continuously adjustable by remote control as well.
- The given values of damping and contact pressure are not influenced by wear or aging.
- There is no backlash in the feeding drive.
- The active damping spreads the stable range of operation (operation speed, width of the film, material and thickness of the film).
- All functions are integrated in one drive.

REFERENCES

1. Ramamurty, R.V., Pagilla, P.: "Effect of Compliance and Backlash on the Output Speed of a Transmission System", Proceedings of the Eighths International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 2005, 219-238.
2. Roisum, D.J.: "Optimization by Integrating Engineering and Business Models", Proceedings of the Eighths International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 2005, 425-446.
3. Breil, J; Oedl, G; Sieber, B.: "Synchronous Linear Drives for Many Secondaries with Open Loop Control", Proceedings of the 2nd International Symposium on Linear Drives in Industry Applications. LDIA 1998, Tokyo 142-146.
4. Breil, J; Sieber, B.: "New Developments for a Linear Motor System with multiple Carriers", Proceedings of the 4th International Symposium on Linear Drives in Industry Applications. LDIA 2003, Birmingham, UK, 21-24.
5. Oedl, G.: "Tension Control in Thin Film Production Lines", Proceedings of the Eighths International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 2005, 239-253.
6. Patent PCT/EP 02/09149 (pending).
7. Schreiber, U.; Sieber, B.: "Aktive Dämpfung von biegeelastischen Wellen zur Verbesserung der Qualität in Flachfolienanlagen - Simulation der Anordnungen", VDI- Tagung Mechatronik Frankenthal 2001.
8. Good, J.K.: "The Abilities and Inabilities of Wound Roll Models to Predict Winding Effects", Proceedings of the Eighths International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 2005, 453-524.
9. Jorkama, M.; Von Hertzen, R.: "Two- drum Winder Run Simulation Model", Proceedings of Fourth International Conference on Web Handling, Oklahoma State University, Stillwater, Oklahoma, 1997.
10. Simulation Software ITI – SIM 3.7, ITI GmbH Dresden, Germany.
11. Good, J.K, Covell, S.M.: "Air Entrapement and Residual Stresses in Rolls Wound with a Rider Roll", Proceedings of the Third International Conference on Web

Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 1995, 95-112.
12. Benson, R.C., LaFleche, J.E., Stack, K.D.: "Deformation of Highly Compressed Wound Rolls", Proceedings of the Third International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 1995, 17-30.
13. Jorkama, M., Von Hertzen, R.: "Wound Roll Generated Unstable Vibration on a Two-Drum Winder", Proceedings of the Eighths International Conference on Web Handling, Web Handling Research Center, Oklahoma State University, Stillwater, Oklahoma, 2005, 553-563.

Mechatronic Damping for Contact Rolls in Film Winders

B. Sieber, Brückner Maschinenbau GmbH & Co. KG, GERMANY

Name & Affiliation	**Question**
Bernie Becker, Alcoa, Inc.	What is the maximum size of the wound roll – in other words, what is the stroke?
Name & Affiliation	**Answer**
B. Sieber, Brückner Maschinenbau GmbH & Co. KG	It is about 1.5 to 1.8 meters to a maximum of 2 meters.
Name & Affiliation	**Question**
Marko Jorkama, Metso Paper	How much did the vibration level decrease in your actual application?
Name & Affiliation	**Answer**
B. Sieber, Brückner Maschinenbau GmbH & Co. KG	On the first upgraded line, we could not discern much vibration after the installation. It is not easy to answer this question. We have to eliminate vibration in the line and we adjusted the sampling and the damping constant. By varying the damping constant we were able to eliminate vibration in the winding process. From my presentation, a reduction of 1-10 or more in the system is possible.
Name & Affiliation	**Question**
Marko Jorkama, Metso Paper	What if you increase the feedback gain, can you drive the system unstable?
Name & Affiliation	**Answer**
B. Sieber, Brückner Maschinenbau GmbH & Co. KG	Of course it can. It depends on the resolution in time inside the inverter and the resonances in the system. We could not do hundreds of experiments to determine the limits in a running line.
Name & Affiliation	**Question**
Marko Jorkama, Metso Paper	Did your system ever become unstable during trials you ran?
Name & Affiliation	**Answer**
B. Sieber, Brückner Maschinenbau GmbH & Co. KG	No, it did not.
Name & Affiliation	**Question**
John Shelton, Oklahoma State University	Were you attempting to constrain the contact roller against rocking (the mode of vibration of rocking), not just linear motion. Also related to trying to wind a cylindrical roll with imperfect film, are you trying to constrain it so that it will not wind a tapered roll of web material? Are you trying to make the contact roller parallel with the rest of the rollers or is it free to rock on the winding roll? I have found that you should force the contact roller to be parallel with the other rollers to produce the best rolls.

Name & Affiliation	**Answer**
B. Sieber, Brückner Maschinenbau GmbH & Co. KG	Both of cylindrical rollers work independently, so you have the same force and the same speed, but they can displace totally independently of one another. Thus the problems that you describe could be possible, but we have never witnessed any. Of course, there is communication in the system in between both drives.