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On the Calibration Potential of the Working Rolls of the Mannesmann Piercing Mill

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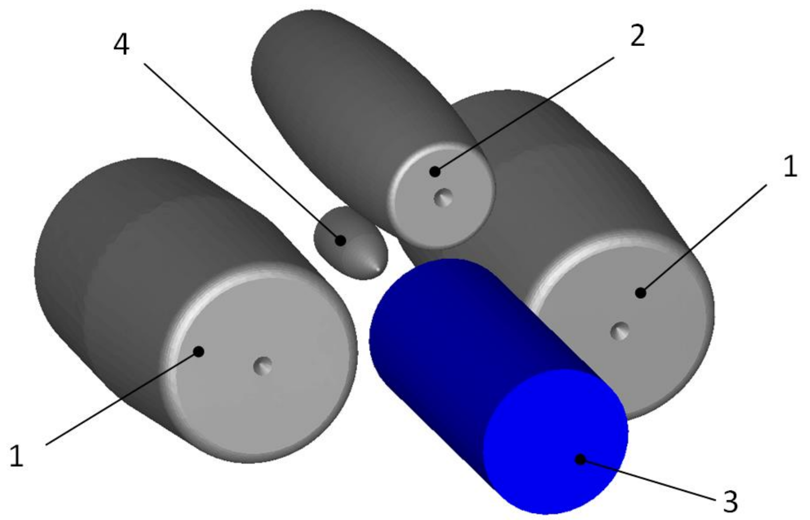
Abstract
The concept of the so called calibration potential is presented. The main idea is that only such conical working rolls A and B of the Mannesmann piercing mill can possess a correct calibration potential, which are in the state ψ(t) of the ordered pair reflected by the phase of this wave function. The fact that only with a correct calibration potential the Mannesmann „tube“ can never become a wavequide is discussed. It is given an practical example, when an error in a nonzero potential leads to a concept of calibration field generating a destroying action of the so called cyclic group Z_4.

Keywords: Ordered pair, calibration potential, wave function, least action

1. Introduction

In the physics of waves (e.g. /1/) we can consider tubes as waveguides. On the other hand, piercing a cylindrical hot metal semiproduct by means of piercing plug between two rotating conical rolls (the Mannesmann piercing process-see the schedule in the figure 1.), we obtain a „tube“ too, but not in a finished state. It means that this rolled tube cannot be considered as a waveguide completely. This is one point of view. Another is that the rolled tube cannot be considered as a wavequide due to its specific internal structure. Thus we can only measure a „distance“ of the Mannesmann process from a wave process generally requiring that this „distance“ cannot be equal to zero or cannot be close to zero. – In the following text, we will introduce a concept of the so called calibration potential as a measure of this „distance“. More concretely, a distance between the mathematical model of the Mannesmann piercing process (MM-process) and the wave equation will be considered as given by the calibration potential K_{AB} of the conical working rolls A and B. In this context we will say that the MM-process is an unique K_{AB}-property of the skew-ordered pair A and B, called MM-system. An existence of the potential K_{AB} will be demonstrated by a contradiction, i.e. it will be shown a practical example of the action of the cyclic group Z_4 as a typical destructive K_{AB}-error.

Figure 1. Basic participating elements of the Mannesmann piercing process



1 – Conical working rolls A and B
2 – Supporting roll (module)
3 – Cylindrical hot metal semiproduct (Input)
4 – Piercing plug

2. Calibration correlation between MM-process and MM-system

In the paper /2/, we have derived the following relation within the logic $L_2(\mathbf{g})$

$$(\partial_i(\log\sqrt{g}\, g_{(ik)})\partial_k)E(K/k) = \partial^t g_a^{\,b},\ \forall x\in\Omega^* \mid t: (0, 1) \to X = L(U)\ , \quad (1)$$

where $[\ln\sqrt{g}\, g_{(ik)}]$ is a correlation matrix worked out of the metrics $g_{(ik)}$ on R^n, $g_a^{\,b}$ deformation matrix, E(K/k) means an embedding of the **g**-geometry of the piercing plug into a space X. This space logically binds a deformation space U and t is a time. The geometry **g** is not incorporated in the equation (1) and we ask, how the form of this equation is minimally changed with respect to **g**, when we let a time change of the deformation matrix vanish in it. Such a task implies one of elementary problems of the calculus of variations, namely that we have to find a square M^2 with such a manner inscribed curve, that all possible lines passing through the given square are intersected by this curve. We therefore consider a curve G $\Leftrightarrow$ **g**, which, via its inscribing into M^2, generates (as an information source) trajectories T of random processes $u \in L_2(\Omega^*)$ demarcating a hole within the MM-process. The field $u_t^{\,t} \equiv \{T\}$ of these trajectories is uniquely able to replace the embedding E(K/k) in (1) and the equation becomes a form

$$h^2\partial_i\partial_i\, u_t^{\,t} + M^2 u_t^{\,t} = 0, \text{ a choice of index t correlates a relation } \wedge \text{ in } (i \wedge a). \quad (2)$$

Within a concept of the square M^2 it is not possible to use a radical $\sqrt{M^2}$ in order to determine a quantity M and „expel“ thus the curve G from M^2. More generally speaking, the curve G cannot be lost by any process $M^2\to M$. Thus we cannot consider this process directly, but indirectly, via a modification of the operator ∂_i in (2) as a problem

$$\partial_i \to \Gamma_i \quad (3)$$

which cannot be solved by means of radicals with respect to the curve G. The equation (2) gets thus the form

$$(ih\Gamma_i\partial_i - M)\psi(t) = 0,\ i = \sqrt{-1}\ \big|\ \psi(t)\wedge\Gamma_i\wedge G \text{ in a time } t \supset t, \quad (4)$$

where the radical $\sqrt{}$, which cannot be used as $\sqrt{M^2}$, is bound by the imaginary unit $i = \sqrt{-1}$ and has no participation in (3). – The quantity Γ_i should now create a radical-free connexion of a state ψ(t) of acting conical rolls C and the curve G. (Acting conical rolls can be in the state ψ(t) of the skew-ordered pair A and B only with respect to G.) This implies the basic configuration of the MM-process as

$$2_\alpha C \supset S^n\ , \quad (5)$$

where the angle α of the inclination of conical rolls cannot be in any way considered as a phase of the function ψ(t). The reason is that the existence of α requires an existence of a phase $\theta(A\wedge B)$ of the function ψ(t) in order to distinguish between the process-quantity α and the system-quantity $\theta(A\wedge B)$. Thus the function ψ(t) implies to be a wave with respect to its existing phase $\theta(A\wedge B)$. Consequently, if we assume an existence of a symmetry in the $A\wedge B$-arrangement, then we should also consider an existence of the symmetrical wavefront for ψ(t) taking into the account that the most simple one is a sphere (let´s denote it as $S(\theta(A\wedge B))$). Reciprocally

$$\exists\, S(\theta(A\wedge B)) \Rightarrow \exists\, S^n\ , \quad (5a)$$

where a torsional sphere S^n can now be responsible for a representation of a stress state of the piercing plug within the geometry **g**. The difference between these both spheres can be further considered as responsible for an induction of the calibration potential K_{AB}. So, in a forbidden case

$$\psi(t)\cap(2_\alpha C\supset S^n) \neq \emptyset\ , \qquad (5b)$$

when the sphere S^n „can become" a wavefront $S(\theta(A\wedge B))$, the phase $\theta(A\wedge B)$ becomes a „geometrical", Berry phase. The potential K_{AB} is then zero or very close to zero.
In the following section we will further work on a notion of the calibration potential, showing after that immediately that it must not form any „calibration field". If namely a „calibration field" is formed, then even a condition that the MM-„tube" cannot be a guide of electromagnetical waves has a destroying impact on the morphology of this „tube". That is that not all conditions of existence of MM-„tube" as no waveguide are sufficient with respect to the preserving of the MM-proces (5). Thus the condition of nonzero K_{AB} is only necessary, not sufficient one.

2.1 Calibration potential of the conical working rolls and its calibration field „error"

Under the notion of **the calibration** of MM-process we very generally understand such an embedding of the pattern (geometry **g**) into „spontaneous processes", which orders them to obtain a character of the flow {u} of metal realizing the deformation space U with respect to the governing (control) function $\psi(t)$.
The calibration potential K_{AB} of both conical working rolls A and B is then that quantity, which „replaces" the function $\psi(t)$ in the equation (4) in such a manner, which just avoids the arrangement $2_\alpha C$ as any its solution.
For an internal and external surface of the deformation space U, the equation (4) becomes a form

$$\left.\begin{aligned}&((\mathrm{int}\sqrt{-1})h\Gamma_i\partial_i - M)K_{AB}(\mathrm{int}) = 0\\ &((\mathrm{ext}\sqrt{-1})h\Gamma_i\partial_i - M)K_{AB}(\mathrm{ext}) = 0\end{aligned}\right\}, \qquad (6)$$

where $(\mathrm{int}\sqrt{-1})$ and $(\mathrm{ext}\sqrt{-1})$ are real numbers which cannot be radicals of any other two real numbers. We search for such a functional prescription f for the angle α satisfying

$$K_{AB}:= f(\delta f(\alpha))\ , \qquad (7)$$

where the symbol δ represents a variation with respect to **g** for

$$\delta K_{AB} = 0. \qquad (7a)$$

Since the both rolls A and B rotate, i.e. there can exist rot f, then it must not exist a rotation

$$\mathrm{rot}\, f(\delta f(\alpha)):= \tfrac{1}{2}(\partial_i K_{AB}(\mathrm{ext}) - \partial_k K_{AB}(\mathrm{int})) \equiv F_{ik}\ , \qquad (8)$$

where the tensor F_{ik} can represent the so called „calibration field" (see /3/ e.g.).
These conditions are satisfied by

$$f(\delta f(\alpha)) \equiv \cos(P_{\mathbf{g}}(\mathrm{asin}\,(\sqrt{(1-z^2)}/z)),\ z = \cos\alpha\ , \qquad (9)$$

where $P_{\mathbf{g}}$ is the winding number for the manifold $K\cup k$ (see also /2/).
We again put consequently

$$P_{\mathbf{g}}(\mathrm{ext}) = gP_{\mathbf{g}}(\mathrm{int}) \qquad (10)$$

for

$$\nabla_\partial\chi = \partial^q\mathbf{u} : \partial g/\partial U \Leftrightarrow \mathbf{u}\ . \qquad (11)$$

The quantity **u** is the only one g-coupled calibration field, which can be regarded in some logical chain. – Here see /2/, i.e.

$$u^\varphi \in L(U) \supset u \in L_2(\Omega^*) \supset \mathbf{u} \in L_2(\mathbf{g}) \Leftrightarrow L(Z(C)), \qquad (12)$$

where C is a differential group and Z(C) the kernel of endomorphism ∂: $C \to C$, $\partial\circ\partial = 0$.

2.1.1 The „error condition" of an avoidance the MM-tube as a waveguide

Using (9) for (8), we exclude the tensor F_{ik} from any electromagnetic field representation by the condition

$$\partial_k F_{ik} = 0 \text{ (for an „electromagnetic field case" it is } \partial_k F_{ik} = 4\pi j_i) \quad (13)$$

and after relatively robust computations we arrive at an externally generated set

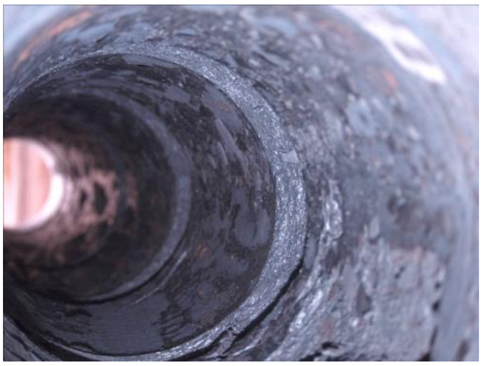
$$\{0, 1, 2, 3\} \quad (17)$$

of values for indeces i and k, so that they must be here replaced by indeces $\mu,\nu = 0, 1, 2, 3$.
The generator of the set (17) comes from the „calibartion field" tensor $F_{\mu\nu}$ in a form of

$$|g_{(\mu\nu)}| - 2\,, \quad (18)$$

with a cyclically „reproduced" winding number $P_{\mathbf{g}}$ for $\partial g/\partial U = 0$. – This makes a deep problem: The set (17) is with respect to the cyclically reproduced $P_{\mathbf{g}}$ isomorphic to the cyclic group Z_4. This group of four elements acts thus on the manifold $K \cup k$ letting symetrically „vanish" 4 rings of metal „realizing" a deformation space U (see Figure 2.). In such a way we can observe in the praxis not only an unique process of acting of Z_4, but consequently also a result of destruction of the MM-tube due to an avoidance it as a waveguide.
Although the callibration correlation between MM-process and MM-system is realized via the nonzero potential K_{AB}, it is not possible to allow an existence of the tensor $F_{\mu\nu}$, which seems to reproduce its values coupled by a winding number cyclically. Therefore it is an isotropic one. So it is absolutely wrong to preserve some isotropy in the MM-tube structure during its creation and evolution within the MM-process. Correspondingly, we cannot measure a „distance" of the equation (2) to the wave equations of the electromagnetic field, but we should already consider the state $\psi(t)$ as a special wave satisfying the least action equation (4). In that sense of an existence of K_{AB} „between" equations (2) and (4) it is excluded any wave as a solution of (2).

Figure 2. Internal image of a destruction of MM-tube (Steel 42CrMo4) by the cyclic goup Z_4



3. Conclusion

We have shown an usefulness of the notion of calibration potential K_{AB} of the pair of conical working rolls of Mannesmann piercing mill. The nonzero potential is a necessary condition of realizing of the Mannesmann process as an unique K_{AB}-property of the system characterized by a special type of wave function $\psi(t)$. – Special in that sense that it can be regarded as a least action with respect to the geometry of piercing plug. Thus the only way, how it is possible to create a sufficient condition of an avoidance of a dectructive existence of the calibration field tensor $F_{\mu\nu}$, is rooted both in a manner of preparation of the input semiproduct structure and in a correct choice of the shape of piercing plug.These both factors namely influence very basically the connection Γ_i between the embedded geometry **g** and the function $\psi(t)$ itself.

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