CONSTITUTIVE DISTRIBUTED PARAMETER MODELLING
OF MOVING COORDINATE SYSTEMS (PART I)

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The moving coordinate systems have underlying significance in classification of the system operations. In spite of this in the world literature these systems have not exactly been described from the point of view of the distributed parameter control of the physical aspects of the technological processes. In accordance with above the physical modelling of the technological processes for the phenomenally distributed parameter control is in convention of pertinent IFAC Meetings “a bridge between control science and technology”. For the realization of this idea in my papers, for example [1-6] is given an original approach to the constitutive description of different kind active media in the constitutive way by the use of the definition of the following derivative \( \frac{D}{Dt} \) [7] and the condition for partial differential equations of the continuity pertinent to balance \( \frac{D}{Dt} = 0 \) [7] as the constitutive invariance for continuous media with the space and time memories [8]. The choice of the state variables in this approach bases on the balance yield and quality control aspects of the activity of the moving coordinate systems [9]. For the considerations underlying significance has the reciprocity principle for the isotropic and anisotropic nonhomogeneous media with the source space and time memories [10].

The Determination of the Multicomponent and Multiactive Moving Coordinate Systems

The object of the considerations of this paper can be presented as follows:

**Definition 1.** Under multicomponent and multiactive media we understand these which
fulfil relations:

- for every state variable $W$ and its every $i$ component $W_i$ for $i = 1, \ldots, I$ is fulfilled the balance relation
  \[ W = \sum_{i=1}^{I} W_i \quad \text{(D1.1)} \]
  and

- for every source element pertinent to the balance of $i$ component and $j$ activity is:
  \[ \sum_{i=1}^{I} \sum_{j=1}^{J} S_{ij} L_j \quad \text{(D1.2)} \]
  where: $L_j$ — the mass factor of the source kg/molm$^3$.

**Definition 2.** The movement of the moving coordinate system is connected to the introduced a general field vector velocity $\mathbf{v}$ which is related to the $i$ component field vector velocity $\mathbf{v}_i$ for $i = 1, \ldots, I$ according to formula (D1.1)
  \[ \mathbf{v} = \sum_{i=1}^{I} \mathbf{v}_i \quad \text{(D2.1)} \]

Consequently to the above formalization of the object of our considerations we introduce:

**Definition 3.** The activity $j$ of the $i$ component active media bases on both handside kinetics influences of the source:
  \[ i \xrightarrow{\text{kinetics}} j, \quad i = 1, \ldots, I; \ j = 1, \ldots, J \quad \text{(D3.1)} \]
  pertinent to the physicochemical properties of the media.

For the considerations of this paper the following assumptions remain valid:

**Assumption 1.** All components $I$ cooperate together with all $J$ activities of the source elements independently to mass, energy and momentum balances.

And subsequently: