On The Semantic Position of properties, primitive particles and semantic structures

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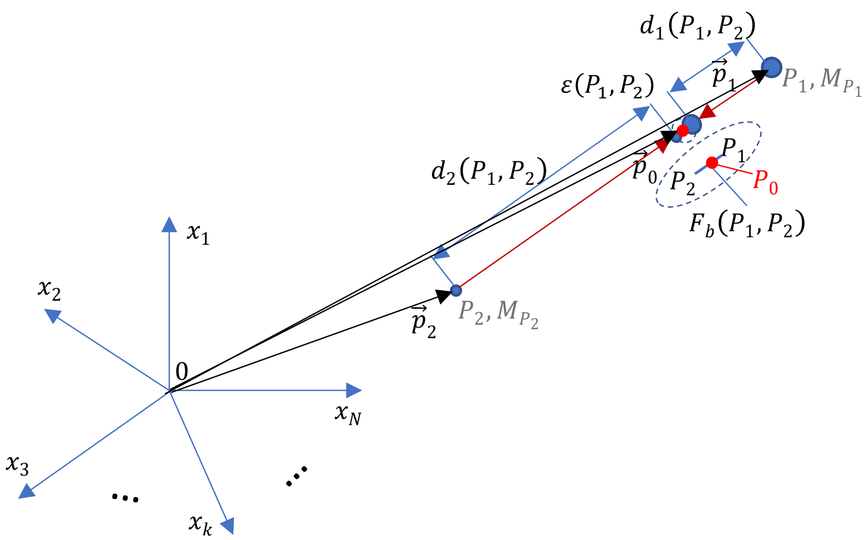
Each property has inherent semantic signature which describes its semantic meaning in isolation, *in situ*. It also serves as its *initial semantic position* in Semantic Space. Each property also has specific semantic mass based on which it is determined its path from the root in the particle property tree. The semantic mass of a property is determined based on the semantic information content a property conveys: $Property\ Mass \sim Property\ Valence \times Information\ Content$ or in symbol notation $M_P = |V_P| \times IC$ where $|V_P|$ is the valence and IC is the information content of the property. Certain properties have the affinity to bind to multiple child properties which reveal additional details for the semantic information provided by the parent. The more child properties a parent property can bind to - the higher will be its property valence.

Two property system

Let us assume we have two properties P_1 and P_2 which are attracted by a binding force $F_b(P_1, P_2)$. The masses of each of the properties are M_{P_1} and M_{P_2}.



On the Figure above are depicted the two properties positioned in the N-dimensional semantic space *in situ* with grey color. Each of the properties is represented by blue oval where the oval with larger diameter corresponds to the larger semantic mass, in this case P_1. After the binding force F_b is applied to those *in-situ* properties they move to a bound state as depicted in the Figure. Note that in their bound state the semantic positions of the two properties are still $\varepsilon(P_1, P_2)$ distance apart. Generally, the semantic distance ε setting apart any two bound properties will depend on the binding force between the properties which in turn depends on the presence of specific regions in each of the properties. For details follow the discussion in Note on Binding of Association Property to Semantic Properties. The parameters d_1 and d_2 represent the semantic distances which each of the properties P_1 and P_2 has travelled accordingly until reaching bound state. ~~The semantic distances are inversely proportional to the ratio of the semantic masses for each property:~~

$$\cancel{\frac{d_1}{d_2} \sim \left(\frac{M_{P_1}}{M_{P_2}}\right)^{\alpha} \text{ where } \alpha > 0}$$

Let us denote with P_0 the center of mass of the two-property system (P_1, P_2). With the vectors $\vec{p}_1$ and $\vec{p}_2$ we denote the positions of the two properties in Semantic Space. With $\vec{p}_0$ we denote the position of the center of mass of the two-property system. Obviously, we have:

$$\vec{p}_0 = \frac{M_{P_1}}{M_{P_1}+M_{P_2}}\vec{p}_1 + \frac{M_{P_2}}{M_{P_1}+M_{P_2}}\vec{p}_2$$

Let us denote with $\varepsilon_1(P_1, P_2)$ the distance between the bound property P_1 and the semantic center of mass P_0 for the ensemble. Likewise, with $\varepsilon_2(P_1, P_2)$ we denote the distance between the bound property P_2 and P_0. Then

$|\vec{p}_1 - \vec{p}_0| = d_1 + \varepsilon_1$ and $|\vec{p}_2 - \vec{p}_0| = d_2 + \varepsilon_2$

Let us assume the following relationship for ε_i

$\varepsilon_i \sim C(P_1, P_2){M_{P_i}}^{-\alpha}(d_i + \varepsilon_i)$ where $\alpha > 0$

So the larger the mass of the property P_i the closer to the semantic center of mass of the V-particle P_i will end. Also, if the original position of P_i is more distant from the center of mass then the end position of P_i will be proportionally further from the same center of mass.
We can rewrite the last relationship as:

$\varepsilon_i \sim \frac{C{M_{P_i}}^{-\alpha}}{1-C{M_{P_i}}^{-\alpha}} d_i$ where $\alpha > 0$ and obviously $C{M_{P_i}}^{-\alpha} < 1$

we write

$d_1 = \frac{M_{P_2}}{M_{P_1}+M_{P_2}}|\vec{p}_1 - \vec{p}_2|$ - $\frac{C{M_{P_1}}^{-\alpha}}{1-C{M_{P_1}}^{-\alpha}} d_1$ which becomes:

$$d_1 = \frac{M_{P_2}}{M_{P_1}+M_{P_2}} \frac{|\vec{p}_1 - \vec{p}_2|}{1-C{M_{P_1}}^{-\alpha}}$$

$$d_2 = \frac{M_{P_1}}{M_{P_1}+M_{P_2}} \frac{|\vec{p}_1 - \vec{p}_2|}{1-C{M_{P_2}}^{-\alpha}}$$

$$\frac{d_1}{d_2} \sim \frac{M_{P_2}}{M_{P_1}} \frac{1-C{M_{P_2}}^{-\alpha}}{1-C{M_{P_1}}^{-\alpha}}$$

The last relation can be interpreted as inverse relationship between the semantic mass of a particle and and its travelling distance – the larger the mass of the property the longer it travels until it reaches its final position.

The center of mass of the two-property ensemble represents the position of the ensemble in Semantic Space. The migration distances d_1 and d_2 represent how much the semantic position of each property has changed (migrated) since creating a bind and forming the ensemble.

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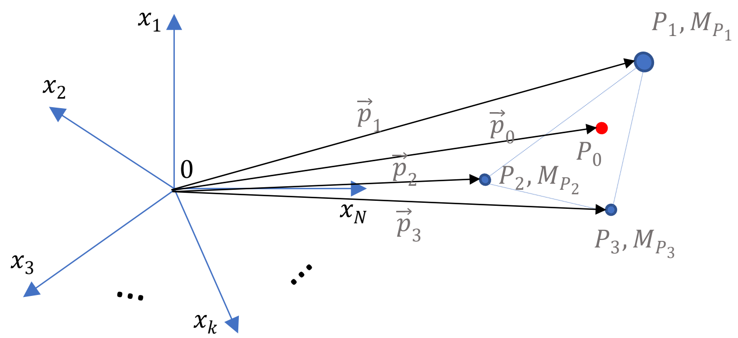
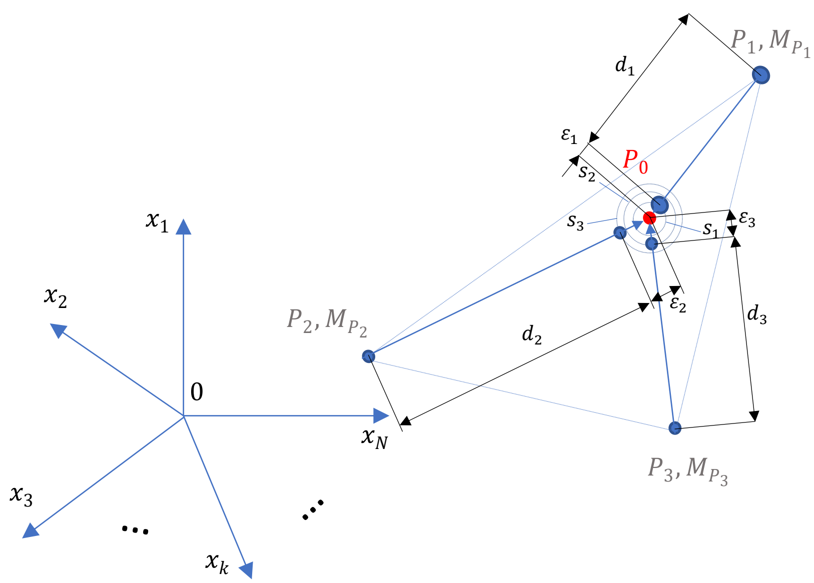
Three property system





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