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ENRICHMENT OF INNER INFORMATION REPRESENTATIONS IN BI-DIRECTIONAL COMPUTING ARCHITECTURE FOR TIME SERIES PREDICTION

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Abstract. *A bi-directional computing architecture for time series prediction, which computes signal transformations for forward-time direction (present → future) and backward-time direction (present → past) bi-directionally, has been applied to several prediction tasks, and it shows a better score than the conventional uni-directional technique. But its detailed mechanism for an improvement of predicting accuracy has not been clear yet. Then, in order to solve this problem, the model's responses are investigated based on the principal component analysis approach in this paper. As a result, it is found that cooperation between the future and past prediction subsystems leads to enrichment of the inner information representations, and it gives the bi-directional model an advantage on signal processing abilities.*
Keywords: Bi-directional neural network model, Time series prediction, Inner information representation, Enrichment, Development process

1. **Introduction.** There are numerous time-variant phenomena in this world. Even thought some of them might have periodicity, it is natural that most of them does not have periodicity. This fact reminds us of a proverb such that *no one knows what may happen tomorrow*. And, uncertainty of prospects for the future attracts our interest to predicting future values accurately, or more accurately, based on the present and previous information.

Time series prediction is a simple but challenging task to estimate future behavior, and it has been examined by a lot of researchers with both different architectures and various kinds of data sets. Among them, most models are adopted a *uni-directional* computation style, which computes only the *forward-time* signal transformation from present to future, for aiming at perfect prediction [1-4]. On the contrary, a new concept of *bi-directional* computation style, which computes not only the forward-time direction but also the *backward-time* direction, was proposed several years ago [5]. Its original concept is inspired by a biological information processing, because our activity is quite smart all the time with the help of sensorimotor coordination [6].

As a result of the previous studies with different data sets, it is concluded that the proposed bi-directional technique makes a better score in trainability, generalization, and prediction quality than the conventional uni-directional technique [5-9]. In spite of such empirical tendencies, the mechanism for an improvement of predicting accuracy has not been clear yet. Then, in order to solve this tough problem, the model's responses are