Distinguishing Anticipation from Causality: Anticipatory Bias in the Estimation of Information Flow

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We report that transfer entropy estimates obtained from low resolution and/or small data sets show net information flow away from a purely anticipatory element whereas transfer entropy calculated using exact distributions show the flow towards it. This means that for real-world datasets anticipatory elements can appear to be strongly driving the network dynamics even when there is no possibility of such an influence. Furthermore, we show that in the low resolution limit there is no statistic that can distinguish anticipatory elements from causal ones.