Earthquake Magnitude Estimation Based on a P-Wave Growth Property

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To estimate earthquake magnitude (M) for early warning systems, we propose a new method that uses the departure time (T_{dp}) from P-wave similar growth. Because T_{dp} correlates with the final M before the arrival of the peak amplitude (i.e., the completion of rupture), the proposed technique enables us to determine the final size of earthquakes approximately 70% faster than conventional approaches. By examining a strong-motion dataset observed from events up to $M7+$, we demonstrate that the root mean square (RMS) residual between M_w and M_{Tdp} (M estimated from T_{dp}) is approximately 0.5 in magnitude unit. We conclude that the proposed method can be useful to improve the safety of running trains while earthquake rupture is underway.