**Predicting the Next Five Minutes: Introducing Team‑Separated Flow States in Soccer**

**Introduction — (State‑Space Basis, Five‑Minute‑Ahead Prediction)**  
“Momentum” in soccer is often debated. We take an operational view and define flow as a latent state accumulated by events: when the team in possession produces events, the state updates; when the opponent has the ball, the state only predicts forward (natural decay). Because each team’s flow can diverge within the same match, we enforce a frame‑level team‑separated *Duel‑stream* update so that updates/predicts are cleanly split by team. We regard flow as *measurable* if it yields additional out‑of‑sample predictive power *five minutes ahead* for xT/xG/possession.

**Methods —**  
Using public data (292 matches), we build multi‑view features on attack (line‑breaking passes, Zone‑14/box entries, sequence metrics, etc.) and defense (gap/line‑gap, defensive success, blocks/clearances, etc.). We fit a local linear state‑space model with exogenous inputs and strictly apply the team‑separated *Duel‑stream* update at every frame to prevent cross‑team leakage. OLS serves as the baseline. Our primary criterion is five‑minute‑ahead OOS RMSE. The split is a deterministic 80/20 rule by match id, and audit logging verifies the frame‑level update/predict separation.

**Results —**  
Across six panels, the state‑space model consistently reduces OOS error vs. OLS for five‑minute‑ahead forecasting (e.g., attack‑xT 0.1386→0.1175 (−15.3%), attack‑xG 0.1637→0.1497 (−8.6%), defense‑xT 0.1273→0.0997 (−21.7%), defense‑xG 0.1485→0.1359 (−8.5%)), while improvements for possession (hold) are small (~0.3%). Coefficient signs align with domain knowledge (e.g., positive for line breaks and deep‑zone entries; negative for off‑post misses). Audit snippets confirm the team‑separated *Duel‑stream* update on each frame.

**Conclusion —**  
This study models momentum as a measurable latent flow, prevents cross‑team contamination via a team‑separated *Duel‑stream* update, and delivers practical five‑minute‑ahead gains on xT/xG using public data.

Limitations include modest signal sizes and limited gains for possession. We outline follow‑ups—placebo and label‑swap tests, window‑length sensitivity, and integration of tracking‑derived pressure/vision options.

In short, within a state‑space framing, flow can be measured and it improves prediction.

