Decision–xT (D-xT): Context-Aware Penalization of xThreat Based on Decision Quality

Introduction

Expected Threat (xT) is a widely used metric to evaluate players' actions based on how much they increase the likelihood of scoring. This submission brings a new dimension to the xT metric by introducing a context-aware decision-quality measurement system that penalizes xT values resulting from non-optimal decisions. Using SkillCorner's passing options concept, I propose the *Decision–xT (D-xT)* metric that adjusts traditional xT values by incorporating decision quality and penalizing actions that reflect suboptimal decision-making.

Method

For each on-ball possession with multiple passing options available, a context-aware utility value is computed to assess and rank the options. For each option i, first, the attacking expected value A_i is estimated, defined as the product of pass completion probability and the resulting xT gain if the pass is completed:

$$A_i = p_i^{\text{comp}} \cdot \Delta xT_i, \tag{1}$$

where p_i^{comp} is the probability of completion for option i, and ΔxT_i is the xT gain conditional on completion.

To account for downside risk, a turnover expected value T_i is computed as the probability of pass failure multiplied by a bounded risk multiplier derived from pass difficulty, relative pass distance within the option set, and defensive pressure at the target location:

$$T_i = p_i^{\text{fail}} \cdot r_i, \tag{2}$$

where $p_i^{\text{fail}} = 1 - p_i^{\text{comp}}$ and $r_i \in [0, 1]$ is a bounded risk multiplier.

Decision context is incorporated through a risk parameter ρ_i, modelled via a bounded sigmoid function of pitch zone, player role, defensive pressure, and match urgency (time and score):

$$\rho_i = \sigma\big(g(\text{zone}_i, \text{role}, \text{pressure}_i, \text{urgency})\big), \qquad \sigma(x) = \frac{1}{1 + e^{-x}}. \tag{3}$$

The utility of each pass is calculated as:

$$U_i = A_i - \rho_i \, T_i. \tag{4}$$

With U values available for the chosen and other passing options, a penalty system can be generated. For each possession, the utility of the executed pass is compared to all available passing options. A normalized regret is computed as the difference between the best and chosen utilities, scaled by the within-possession utility spread with a small stability floor:

$$\text{regret} = \frac{\max_j U_j - U_{\text{chosen}}}{(\max_j U_j - \min_j U_j) + \epsilon}, \tag{5}$$

where $\epsilon > 0$ is a small constant for stability.

This regret is mapped to a bounded penalty factor using an anchored logistic function, ensuring no penalty when the optimal option is selected:

$$\pi(\text{regret}) = \frac{1}{1 + \exp(k(\text{regret} - b))}, \tag{6}$$

with parameters $k > 0$ and b controlling steepness and midpoint. In practice, the anchoring constraint is enforced so that $\pi(0) = 1$.

The realized xThreat is multiplied by this factor to obtain penalized xT:

$$\text{D-xT} = xT_{\text{realized}} \cdot \pi(\text{regret}). \tag{7}$$

Results

Across 10 matches (308 player–match observations), Decision–xT (D-xT) reduced total xT from 66.28 to 50.49, corresponding to a 23.8% decrease, indicating that a substantial share of xT arose from suboptimal passing decisions. Match-level reductions were consistent, ranging from 19.0% to 30.1%. At the player level, several high-xT contributors experienced large absolute and relative reductions (exceeding 45%), reflecting frequent selection of lower-utility options. In contrast, decision-efficient players preserved nearly all of their xT, with reductions below 5%, demonstrating that D-xT differentiates contribution based on decision quality rather than volume alone.

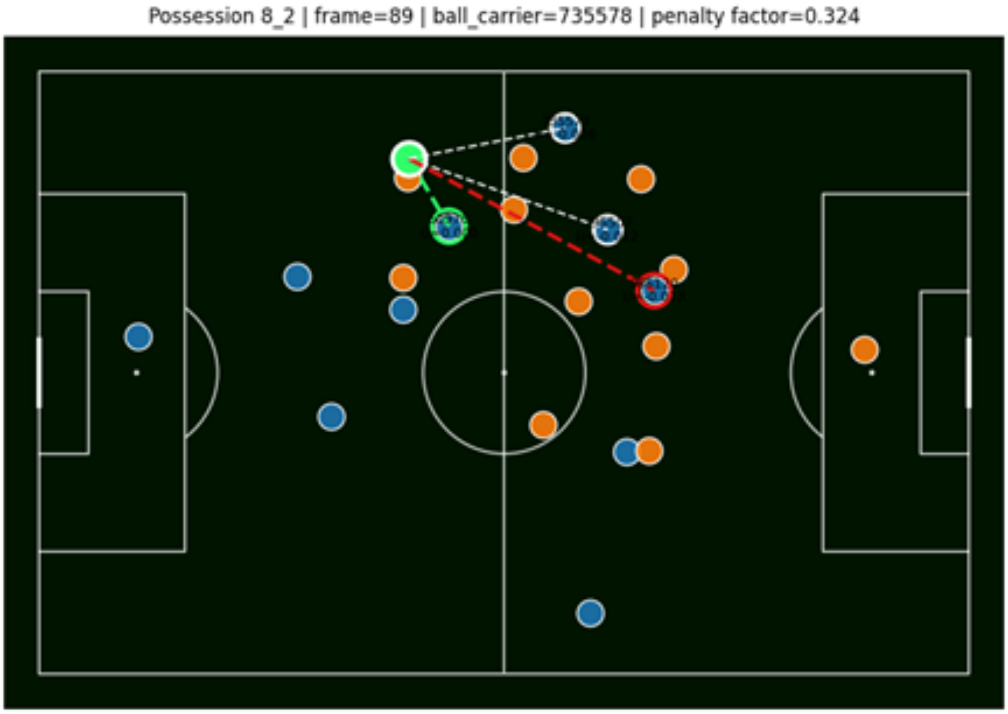

Figure 1: A penalized pass.

Conclusion

This submission illustrates a method to rate passes and penalize their xT based on decision quality with context-aware information and introduces the Decision–xT metric. Future work includes fine-tuning parameters with larger match datasets and incorporating ball-carry options into the calculations.

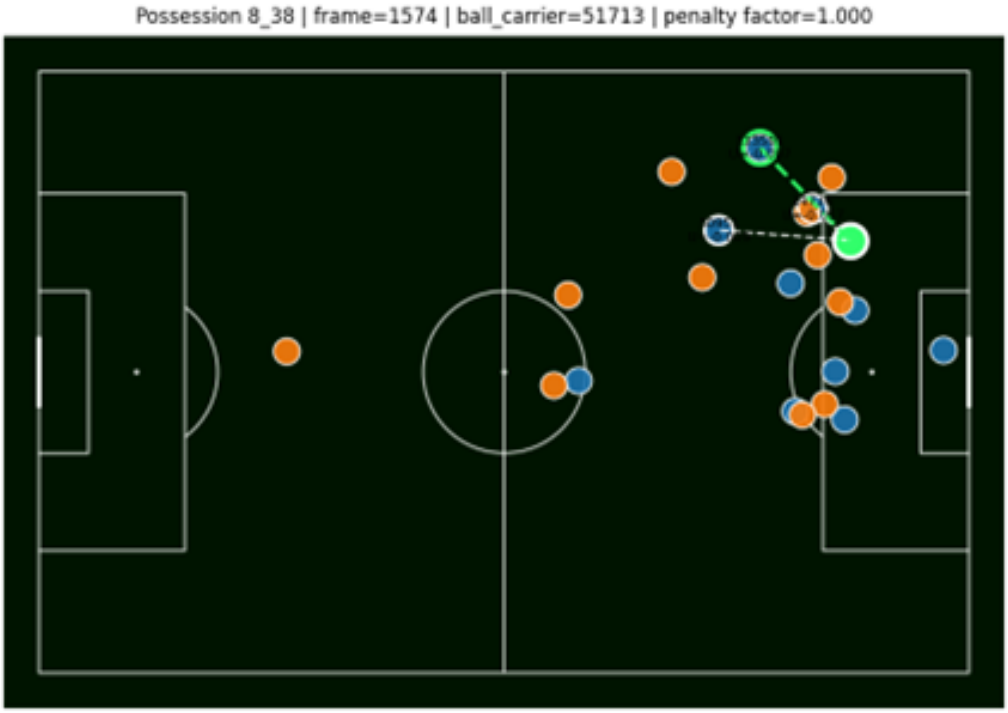

Figure 2: A non-penalized pass.