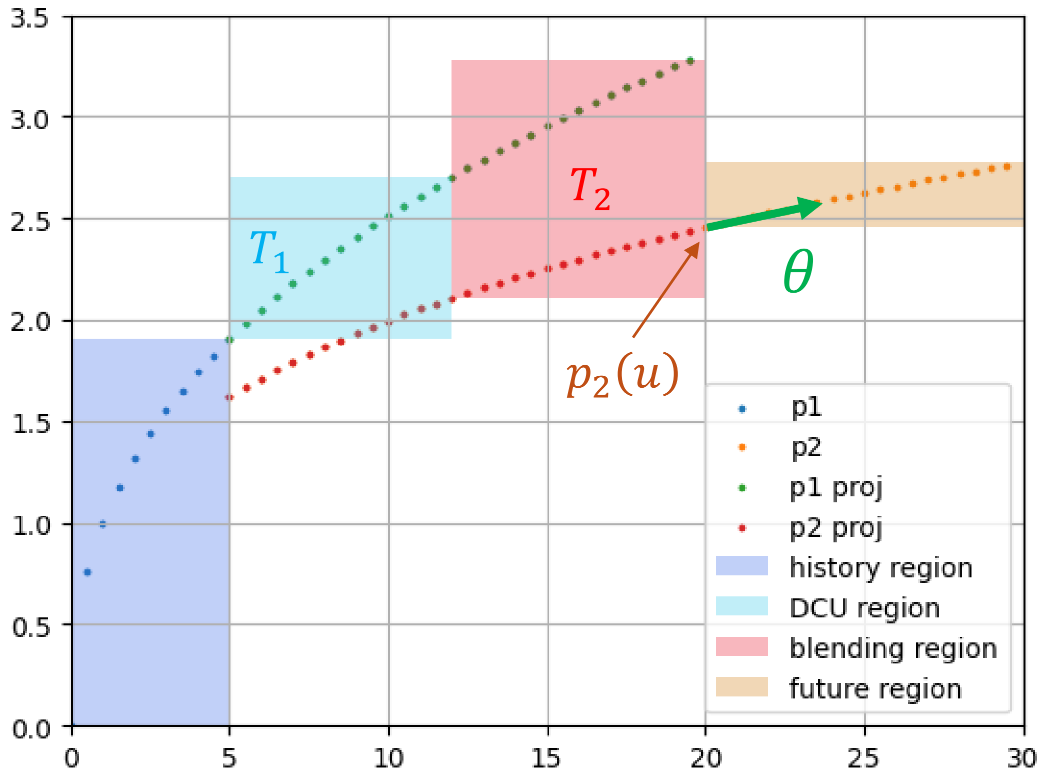
Overview illustration



- Blue is the history region.
- Light blue is the delay compensation region of uncertainty (abbr. DCU) of size defined by T_1 – the time we expect ego to be within this region. We believe that ego is still tracking p_1 during most of this region.
- Red is a finite blending region of size defined by T_2 (detailed later) that we expect the blending of p_1 and p_2 to occur.
- Orange is the future region to track p_2.
- Green arrow is the derivative of p_2 at point u with angle θ.

Solution Requirements

1. Follow p_1 in the history region (blue)
2. In the DCU (light blue) region, follow p_1 for most of the duration
3. Blend p_1, p_2 during the blending region (red)
4. Follow p_2 in the future region (orange)
5. Strive to maintain the derivative at the point dictated by the green arrow

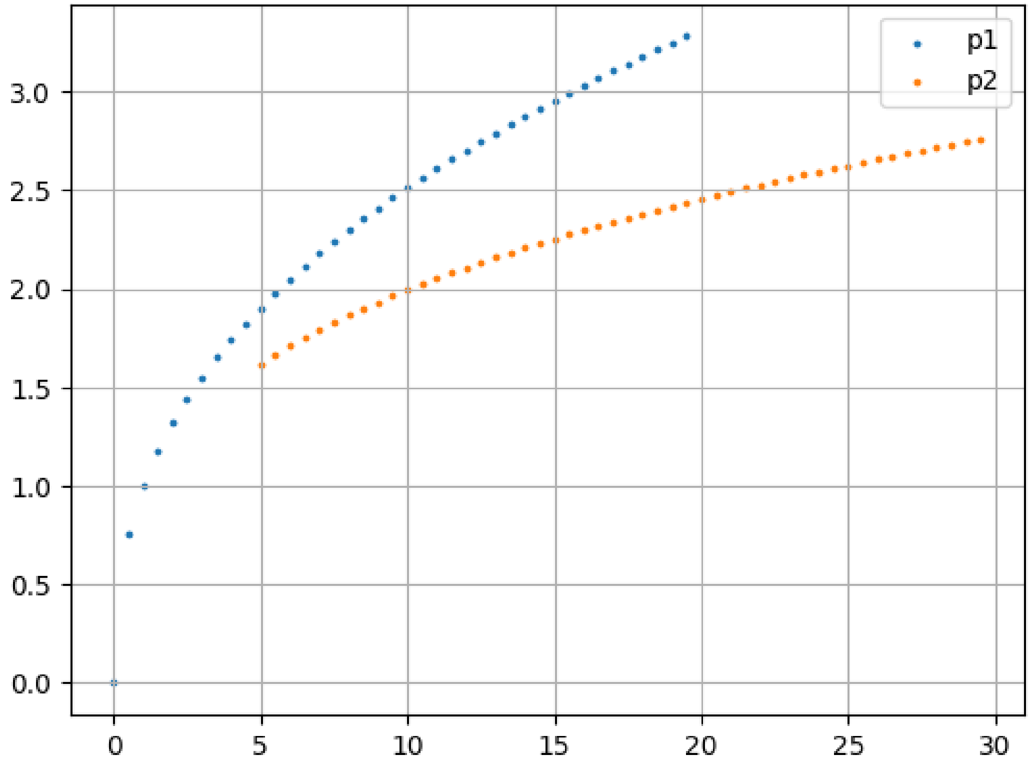
Solution Proposal

Inputs

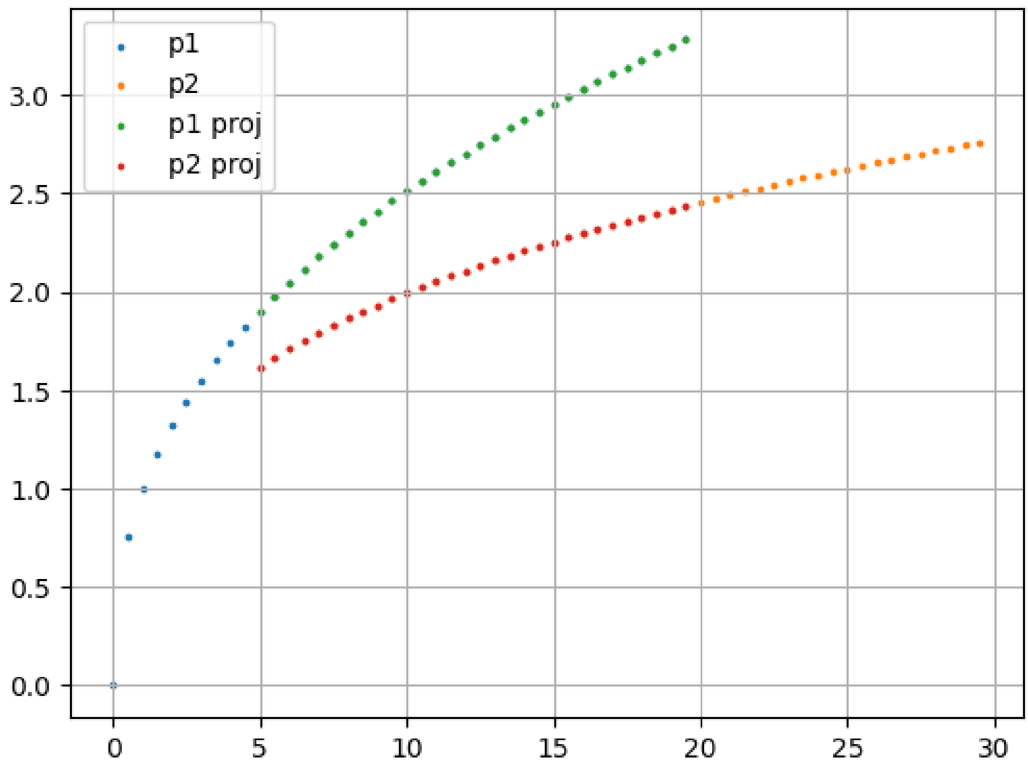
1. Paths p_1, p_2
2. Region times T_1, T_2

Algorithm

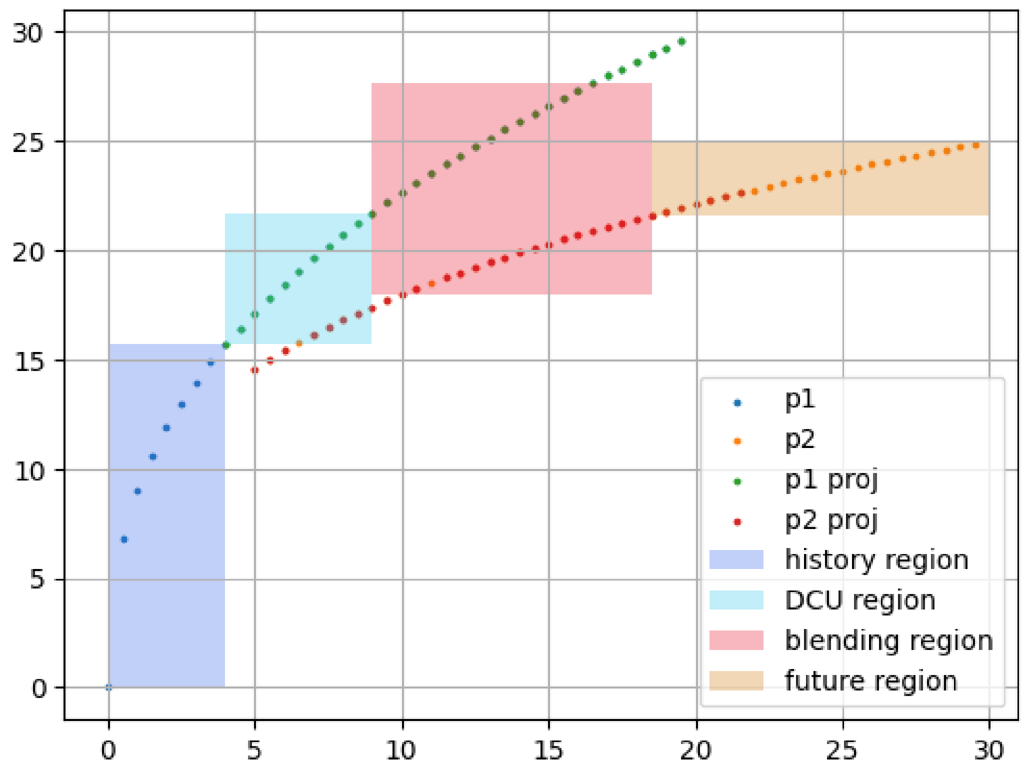
Given two paths



1. Calculate overlapping region of p_1, p_2 in order to define the start of DCU and blending regions



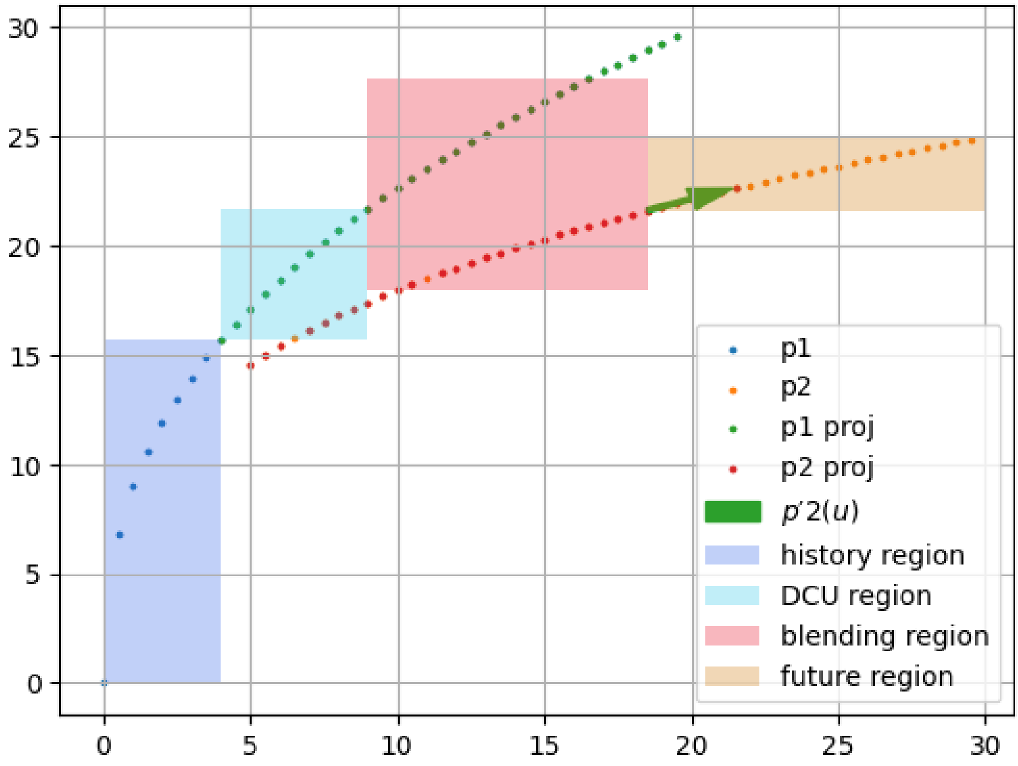
2. Designate the regions using the overlapping regions and T_1, T_2



3. Calculate the angle θ of the derivative at the beginning of the future region. Options:
    a. Fit a spline on p_2 (perhaps there already is one, since we may want to perform the merge after spline). Then calculate the angle at point u
    b. Some high-order derivative approximation. For example:

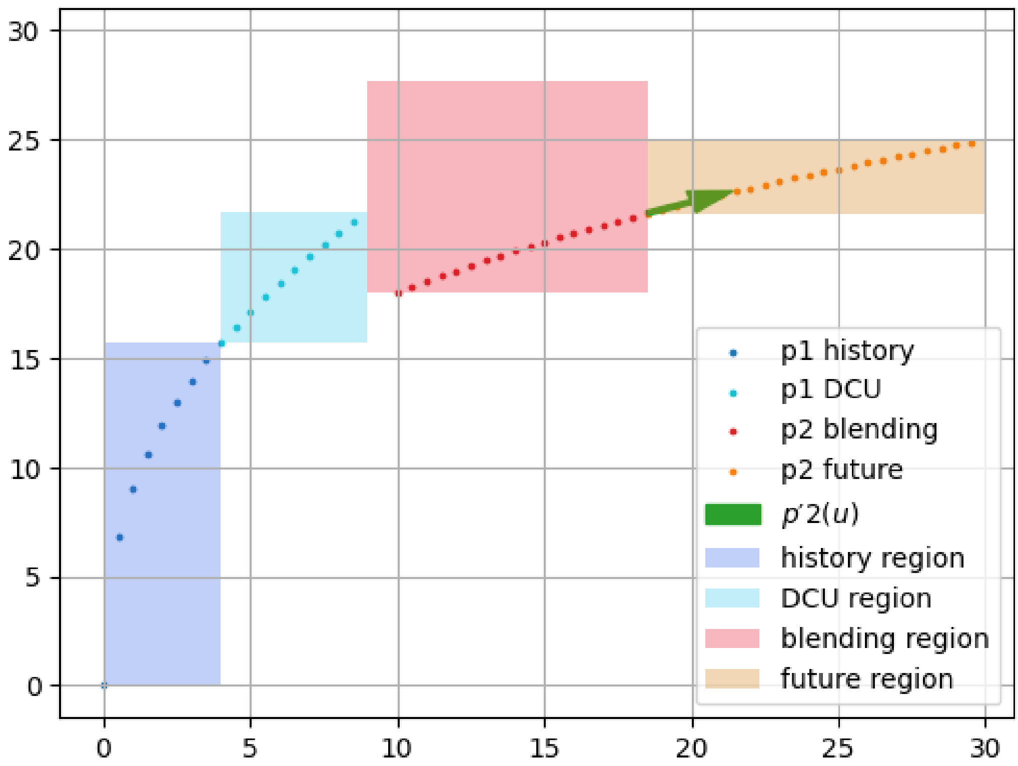
$$f'(x_0) \approx \frac{(x_0 - x_1)^2 \left(f(x_{-1}) - f(x_0)\right) + (x_{-1} - x_0)^2 \left(f(x_1) - f(x_0)\right)}{(x_{-1} - x_0)(x_{-1} - x_1)(x_0 - x_1)}$$

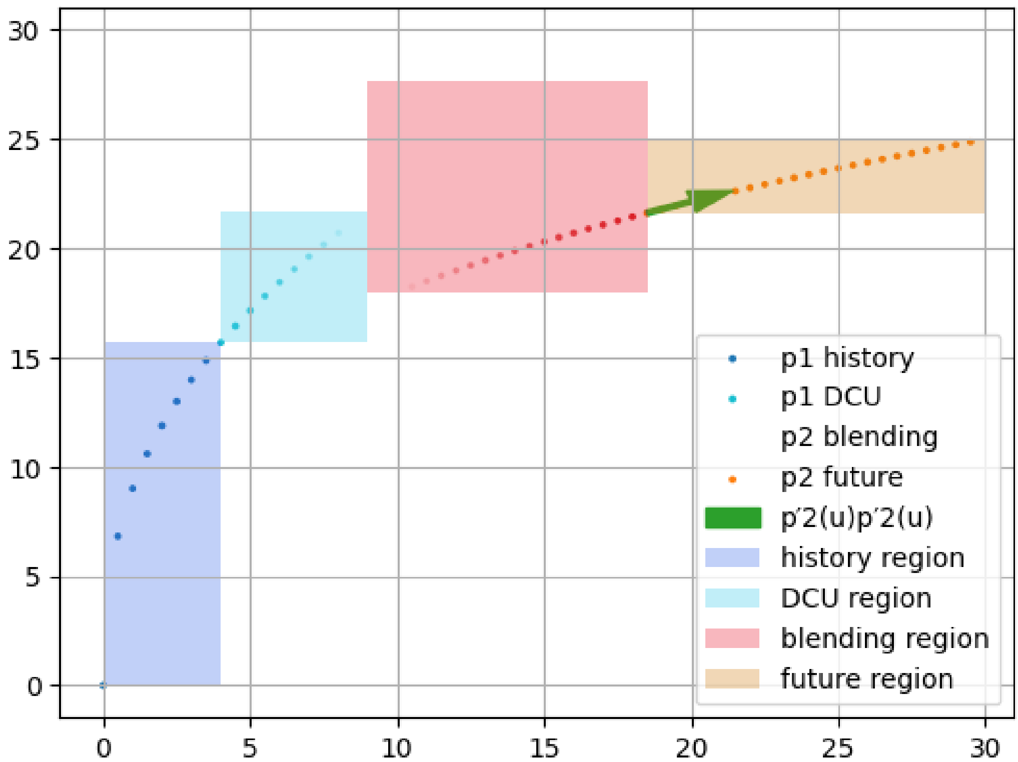
Note: we may be able to assume even spacing if p_2 is the output of a uniformly sampled spline



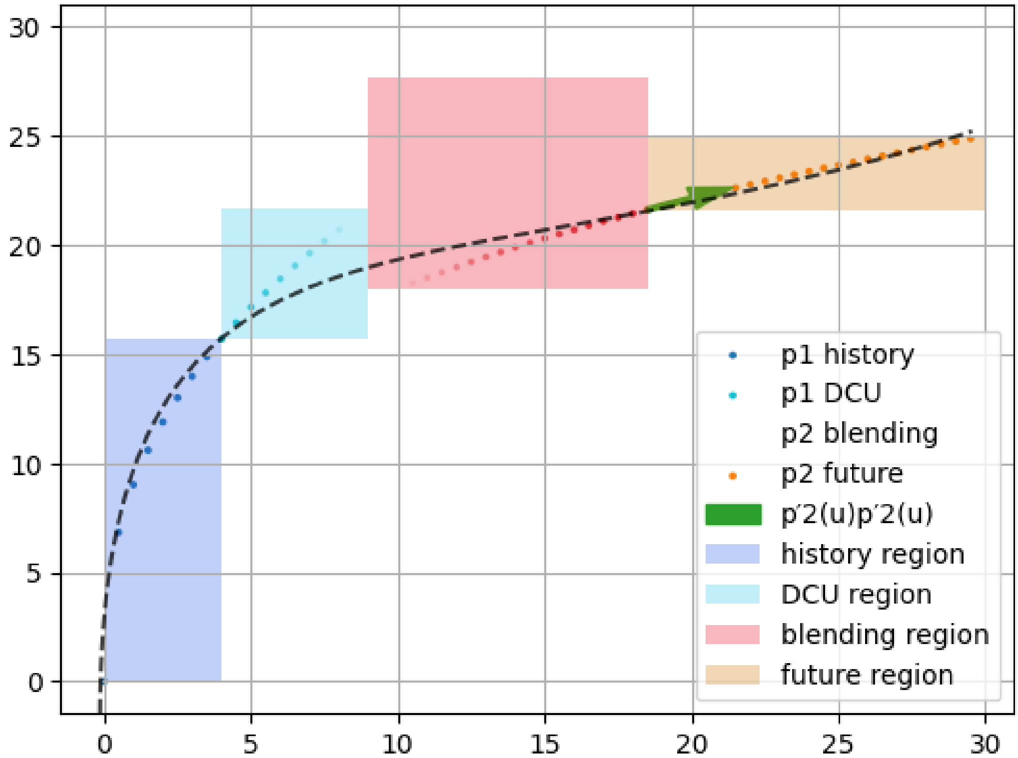
4. Designate weight 1 to all points
5. Remove complexity in the blending region to allow for spline blending. Options:
   a. Remove points from paths p_1, p_2 in the blending region
   b. Keep p_2 points, but weigh them increasingly, starting from 0
6. Designate point weights in DCU to model uncertainty
   a. Incrementally decrease weights in the uncertainty region

7. Recalculate weights with softmax (or divide by sum if too extreme)





8. Fit a spline on the remaining points with their respective weights, with the derivative constraint



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0
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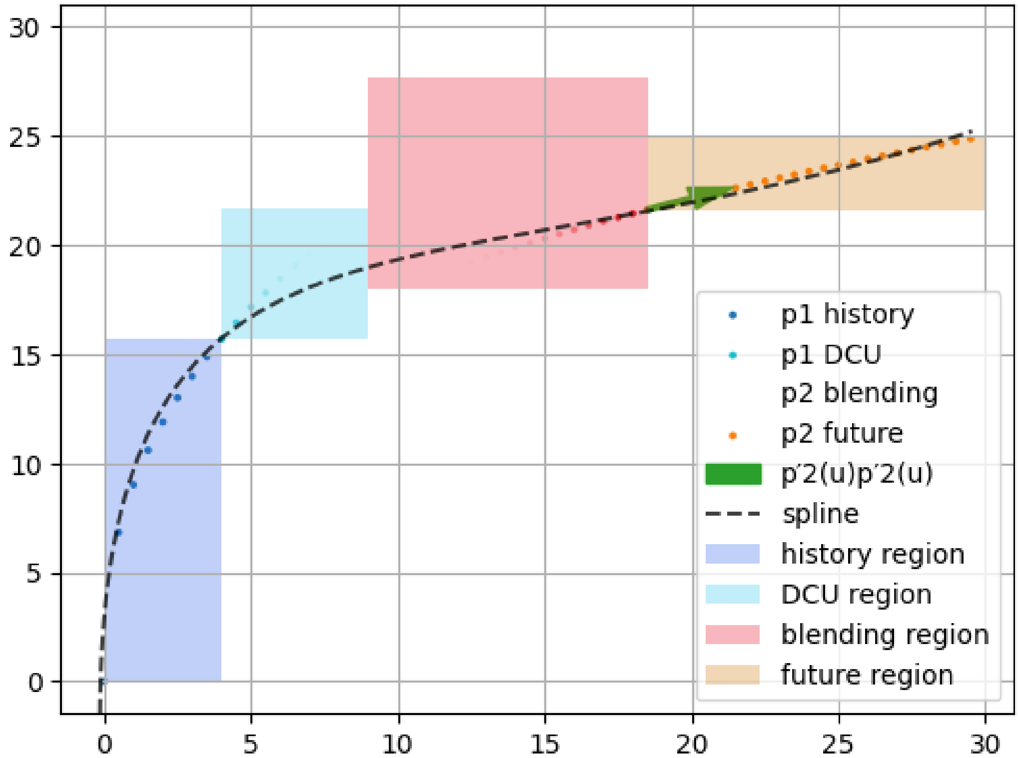
p1 history
p1 DCU
p2 blending
p2 future
p′2(u)p′2(u)
history region
DCU region
blending region
future region



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p1 history
p1 DCU
p2 blending
p2 future
p′2(u)p′2(u)
spline
history region
DCU region
blending region
future region