The development of new heavy flavour jet tagging algorithms has made large progress with the utilization of more complex neural networks during Run 2. These developments are now deployed at trigger level with the DeepJet model exchanging the DeepCSV and CSVv2 algorithms for b-tagging trigger paths. The network is trained on trigger level simulation while previous ones were not trained explicitly on trigger level reconstruction. This application yields a better b-jet identification efficiency while reducing the light-flavour misidentification rate.
Expected Performance of Run-3 HLT b-quark jet identification

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Introduction – Run 3 b-tagging algorithms

The b-tagging and vertexing group has developed new heavy flavour jet tagging algorithms during Run 2\(^1\) that have proven to be superior to older generations\(^2\). However, the old tagging algorithms have still been used at trigger level during Run 2, and will be substituted with state-of-the-art ones for Run 3. Additional trigger paths using the DeepJet\(^1\) neural network are going to be deployed, while CSVv2\(^2\) will not be used anymore. In Run 3 the DeepCSV and DeepJet neural networks are trained on their applied domain, namely on trigger level simulation, whereas the previous ones deployed in Run 2 were not trained on trigger level simulation but rather on full offline reconstruction.

**Run 2 trigger level b-tagging:**
- CSVv2\(^2\) as default algorithm
- DeepCSV as deep learning-based algorithm
  - Has proven to work well during data taking
  - Became new default
  - Was trained on offline reconstruction

**Run 3 trigger level b-tagging plans:**
- Keep DeepCSV as default/fallback
- Add DeepJet\(^1\) tagger
- Train both models on online reconstruction

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The performances of the DeepCSV and DeepJet taggers, trained on different scenarios, are shown. All the algorithms are evaluated on jets with a transverse momentum $p_T > 30 \text{ GeV}$, in an inclusive $t\bar{t}$ -sample of Run 2/Run 3 simulation respectively.

The solid curves show the DeepJet algorithm. The best achievable performance is represented by the black curve, in which the algorithm is trained and evaluated on offline Run 2 simulation (13 TeV). The red curve shows the performance of the DeepJet network retrained on Run 3 trigger-level inputs (14 TeV). This model vastly outperforms the non-retrained model shown in orange, which corresponds to the performance of the baseline DeepJet algorithm trained on Run 2 offline simulation, but applied on Run 3 trigger-level simulation (14 TeV).

The dashed curves show the performance of the DeepCSV tagger considering similar training scenarios. The Run 2 offline performance is depicted in black, the performance of the DeepCSV algorithm retrained on Run 3 trigger-level inputs is shown in red, and the non-retrained model, corresponding to the DeepCSV algorithm trained on Run 2 offline simulation but applied on Run 3 trigger-level inputs, is shown in blue.

The expected performance of all trigger paths using DeepJet will improve in Run 3 with regards to Run 2. Given a $b$ jet identification efficiency of 0.58, the misidentification rate is reduced from $2.6 \cdot 10^{-3}$ to $7 \cdot 10^{-4}$ when compared to DeepCSV, that was used during Run 2. The selected working points are optimized for all the paths, and are in the range 0.25-0.6.