Question 1:

Whether other forms of the sort tracks constraints are allowed? The relationship between the number of sort tracks and the number of blocks formed is very complicated. The latter is not only affected by the number of cars arrived to this station, but also by the cars' OD distribution structure (which stations they go to), the layout of a yard, the length of each track, the arrangement of switches, and so on. For more details, please see the survey of Boysen et al. (2012). Now that such a complex nature, a complete linearization method is simpler than a piecewise linearization. We could still assume that each sort track could reclassify a specified number of cars per day, for example, 200. In that case, in table 6 of the illustrative example, there are four blocks departing from yard Y01, including Y01->Y02, Y01->Y03, Y01->Y05, Y01->Y06 with a consolidated volume of 85, 339, 120, 109 cars, respectively. There are 653 cars in total, so that 3.265 sort tracks are occupied in yard Y01. The greatest benefit is a linear constraint. Therefore, we could emphasis our most interest on how to formulate and to solve the integrated problem.

Response: Other forms of the sort tracks constraints are not allowed in this competition. There are two different concepts of the number of sort tracks and the number of blocks. It is true that some of the researches restrict the number of blocks, however, this is based on the assumption that one sort track is only occupied by one block, which is without generalizability. In fact, more than one sort track (calculated by the track's length) are required for some busy reclassification yards because the sizes of blocks (train services) built in these yards can be larger than 500 cars per day. Thus, it is more general and practical to limit the number of sort tracks. Of course, the problem of the formation of blocks (train service) is very complicated, which constitutes the core of this competition. Please notice that train formation plan we discussed is not a daily plan but a strategic plan for a year (or half, two years, or for a season) considering all the yards in a rail network. Consequently, factors, such as the layout of a yard, the length of each track, are usually simplified into corresponding parameters, for example, C_R^k, $a_1, a_2, \cdots, a_n$ etc. Apparently, a feasible solution can be achieved in this competition. For the eight-yard example, some participants claim that they have obtained better solutions that ours.

Actually, linearization is not a necessary approach to optimize the problem. Given the fact that RAS competition is to select a superior solution from superior solutions, when other quality criterions of solutions are the same, feasible solutions given integer sort tracks constraints are better than unfeasible ones considering fractional constraints (i.e. 3.265 sort tracks you mentioned).

Questions 2 and 3:

Does detour ratio constraint necessarily need to be modeled in the problem or it is a constraint that helps in limiting the number of paths that we consider? To put it in other words, if we can provide a solution which is optimal in terms of cost but some path(s) are longer than the detour ratio, will that solution be acceptable or not?

Response: Considering freight transport is always charged by ton kilometer in rail, consequently, it is unfair if some shipments are shipped by paths with higher detour ratios. Besides, detour ratio constraint can also limit the number of variables. Here we only provide the concept of detour ratio as a reference. If you can provide a solution which is optimal in terms of cost but some path(s) are longer than the detour ratio, it can be acceptable (Of course, under the same conditions, the solution which meets detour ratio constraint is preferred).

The objective function given in the reference of the mathematical model (Page no. 10, Boliang Lin, 2017) and the one given in the problem statement (Page no. 15) document seem a bit different. Can you please confirm which one is correct? Specifically, where should the factor \lambda be multiplied?

Response: The one given in the problem statement (Page no. 15) document is correct. In the model of Boliang Lin (2017), a print error in the objective function (1) should be corrected:

The parameter λ should be multiplied by $D_{ij} \sum_{l \in \rho_{ij}} L_{ij}^{l} \xi_{ij}^{l}$ in the first item, that is,

$$\sum_{i \in V} \sum_{j \in V} (c_i m_{ij} + \lambda D_{ij} \sum_{l \in \rho_{ij}} L_{ij}^{l} \xi_{ij}^{l}) y_{ij} + \sum_{k \in V} \sum_{i \in V} \sum_{j \in V} f_{ij} x_{ij}^{k} \tau_{S}^{k}$$

Where, the parameter λ denotes conversion factor that converts car-mile in kilometer into car hours, i.e., $\lambda = 0.1$.