

Influence of ball bearings modelling on the predicted thermal behaviour of the FZG test rig

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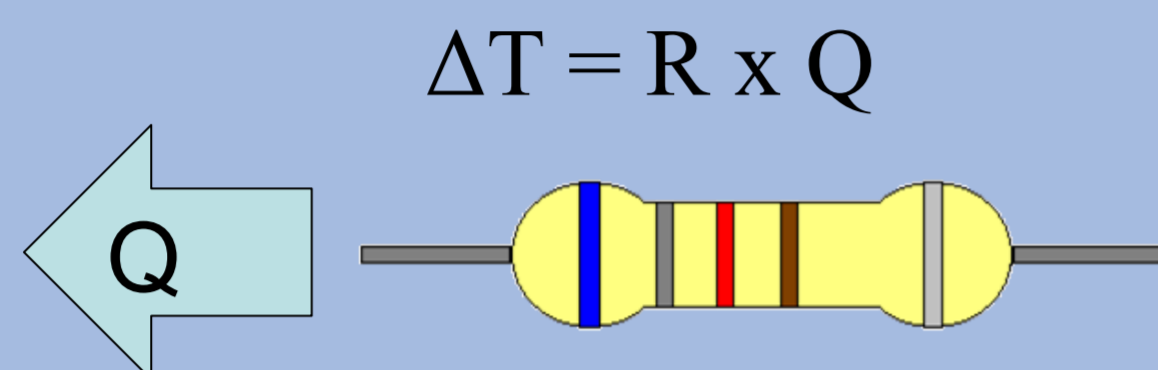
Context : Prediction of operating temperatures in mechanical transmissions

Maintaining acceptable temperatures in gear units is crucial in terms of reliability and lifetime. As an example, and according to the standards, the scuffing risk is evaluated by using gears' maximum surface temperature. This temperature equals $T_{Tooth} + T_{FlashMax}$. Then computing T_{Tooth} accurately is crucial.

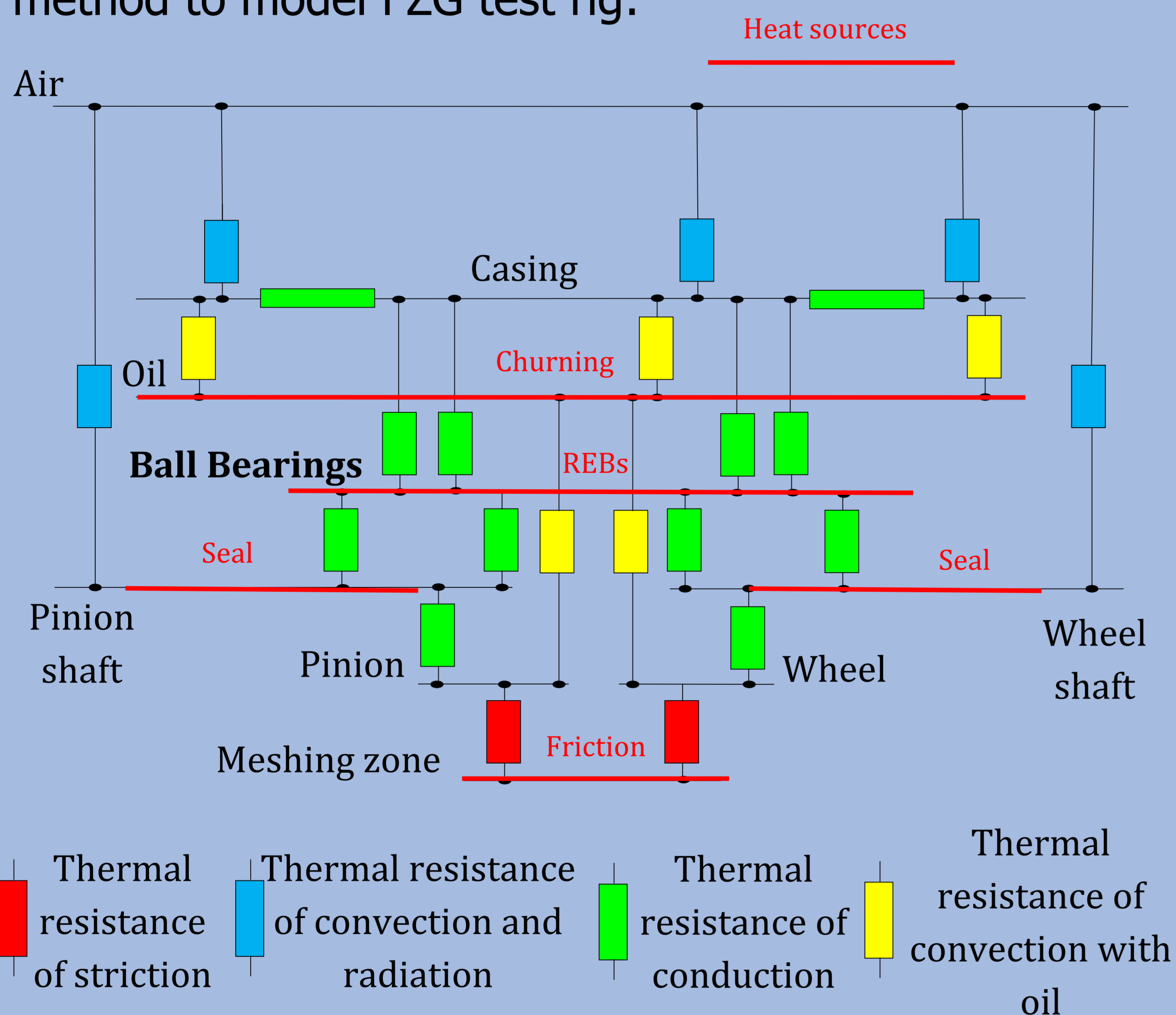
Modeling of the FZG test rig

The thermal networks method is used

Method based on an analogy with Ohm's law in electric circuit theory: $\Delta T = R \times Q$ - where ΔT is the temperature difference, Q the heat flow and R the thermal resistance.

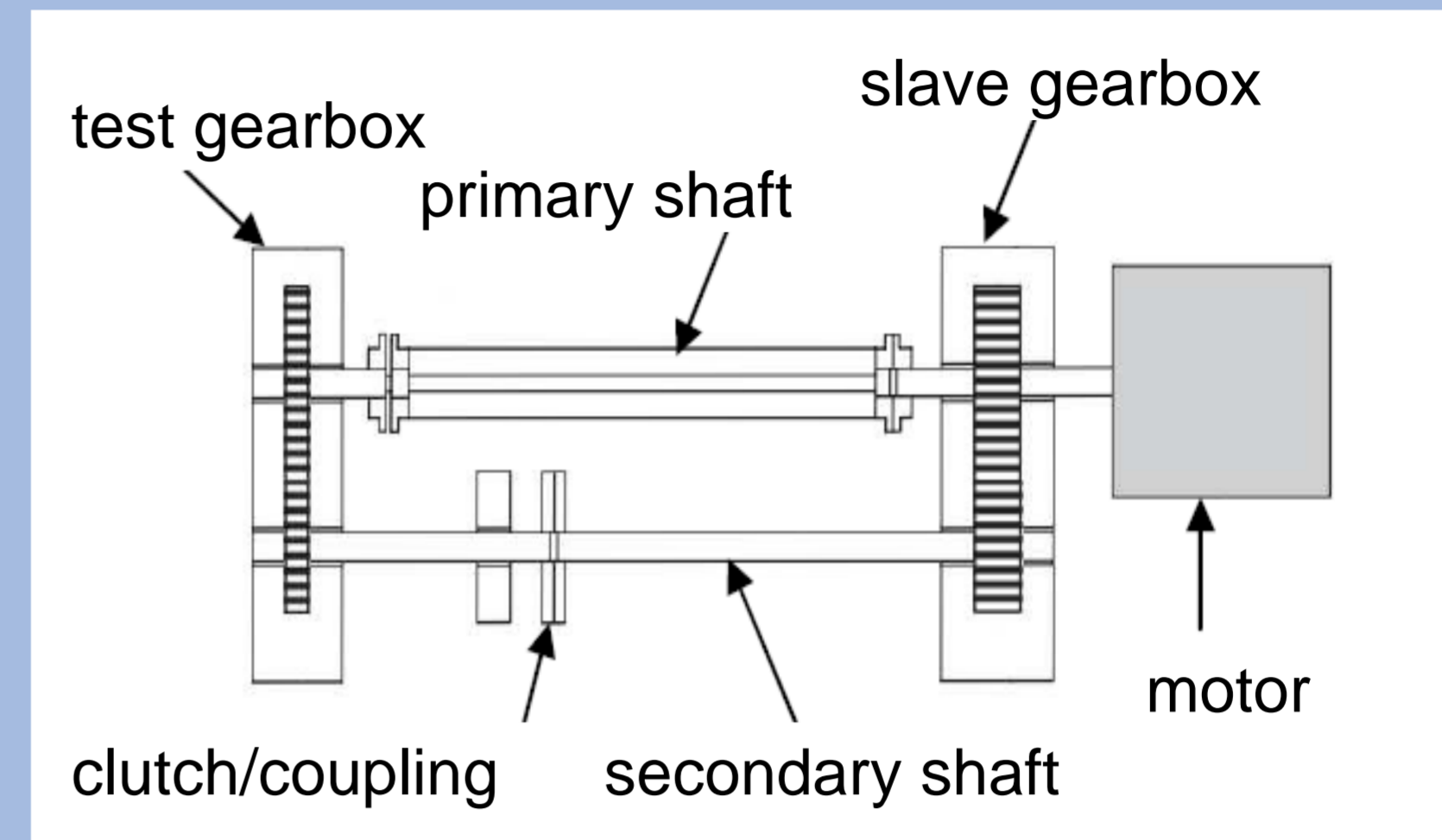


This method allows to compute temperature of several nodes of the gear unit. Thanks to these temperatures, a strong coupling is ensured between power losses and local oil characteristics. Durand *et al.* [1] used this method to model FZG test rig:



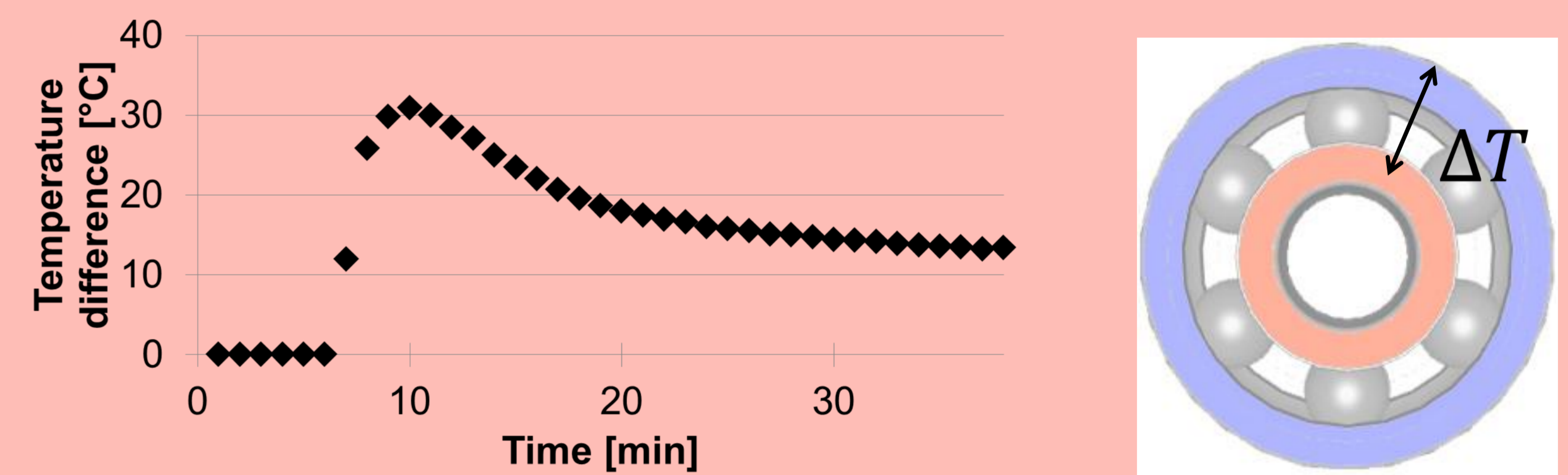
[1] Durand de Gevigney, J. et al. 2012. Thermal modelling of a back-to-back gearbox test machine: Application to the FZG test rig. Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology. 226(6), pp.501-515.

FZG test rig



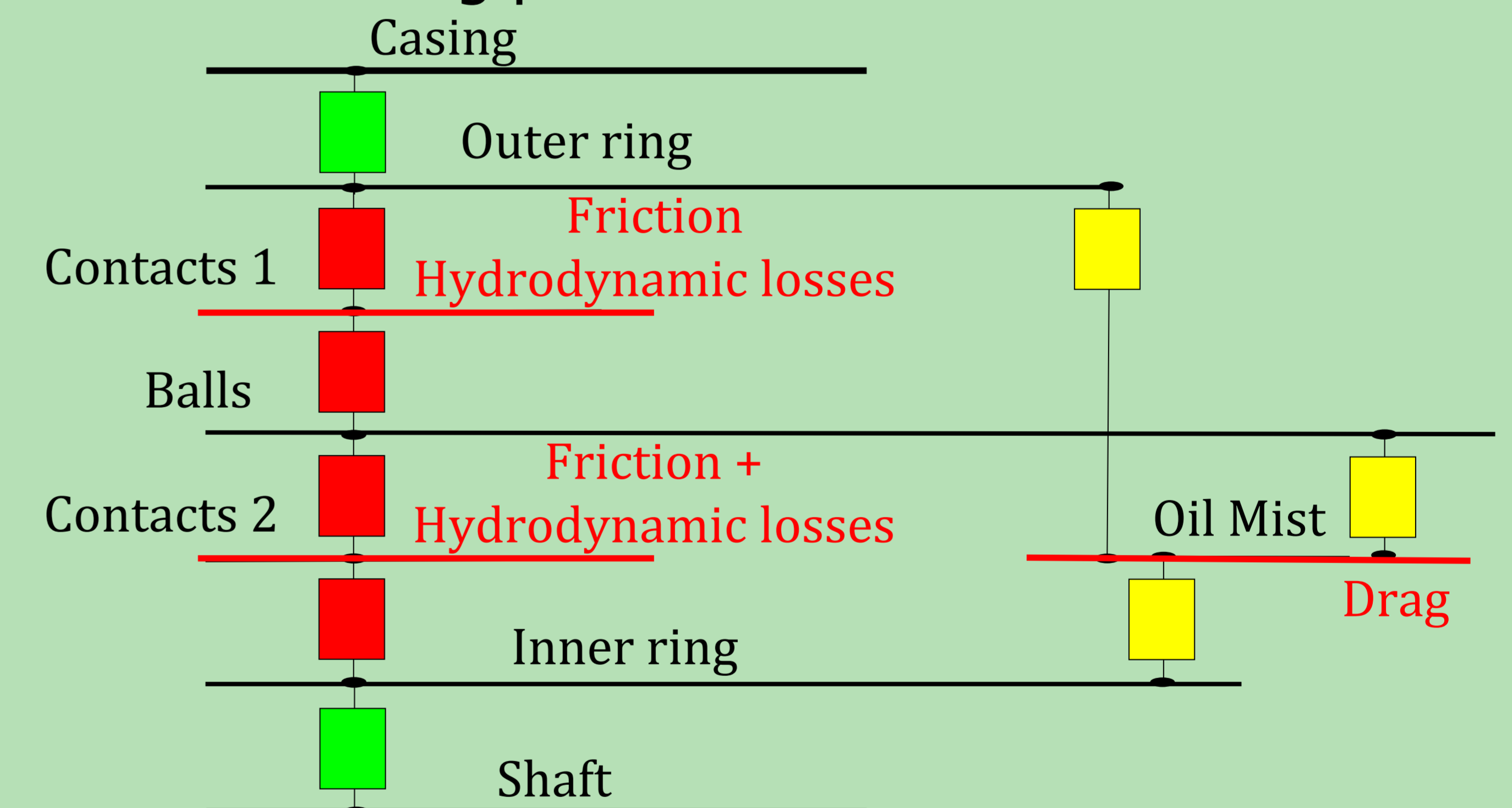
Problem : Bearings rings are not isothermal

Temperature difference between bearing's rings



Answer : More refined bearing modelling

- Several nodes are used to simulate each ball bearing
- A local bearing power loss model is introduced



Discussion and results

- Ball bearings thermal modelling shows a significant impact on gears predicted temperatures
- This impact is emphasized when the gear immersion depth is low
- For high oil levels, the cooling of gears increase and the bearings modelling tends to have less impact on predicted temperatures.

