* The most detailed explanation of the design of zoom lens can be found at <https://github.com/amsikking/any_immersion_remote_refocus_microscopy.> This document does not include any theories behind the design and modelling of a zoom lens as it is far too complicated and way beyond my current knowledge.
* Component list

|  |  |  |  |
| --- | --- | --- | --- |
| **Optical Part** | **Part description** | **Part number (Vendor)** | **Number** |
| Positive group 1 | 300mm aspherical lens | 47649 (Edmund Optics) | 2 |
| Negative group | N 150mm lens | 62495 (Edmund Optics) | 1 |
| Positive group 2 | 250mm aspherica lens | 47647 (Edmund Optics) | 2 |
| **Mounting** | **Part description** | **Part number (Vendor)** |  |
| Linear stage |  | DDS050 (Thorlabs) | 2 |
| Linear stage |  | DDS100 (Thorlabs) | 2 |
| Post | 1'' | RS1 (Thorlabs) | 2 |
| Slip ring |  | SM1RC (Thorlabs) | 3 |
| Mounting plate |  | UPB2 (Thorlabs) | 3 |
| Spacer ring |  | SM1S1M (Thorlabs) | 2 |

* Calculation of desired focal length
  + The magnification of a pair of lenses with light enters from lens one can be described as
  + To avoid spherical aberration at remote refocusing point, the magnification between O1 and O2 needs to be the same as refractive index of the immersion medium
  + Using this microscope setup and water as immersion medium as example:
  + The focal length of an objective lens is an intrinsic value and often not reported by the manufacturer. A list for focal length for objective lens from major manufacturers can be found in <https://amsikking.github.io/microscope_objectives/tube_lens.html>
* Plossl lens:

The shorter focal length of a lens, the greater curvature would be and leads to worse imaging quality. However, it is possible to construct a Plossl lens pair to partially avoid this issue. Essentially Plossl lens is formed using 2 identical aspherical lenses by placing them close to each other and the resulting focal length of the lens pair will be halved compared to individual lenses. In this zoom lens, both positive lens group are constructed this way with spacer ringer separating 2 identical lenses.