Rayleigh Taylor Instability of confined liquids

Problem Statement

Adverse density stratifications are generally unstable in fluid statics. But, if the container in which the stratification is maintained is small enough, we can see that the system becomes stable. For example, water on oil is an unstable system when it is maintained in a large container. If we consider the same system in a thin capillary tube, we can see that the system is no longer unstable. This project is an attempt to quantify the maximum diameter of the capillary tube at which the system remains stable. When we go to such small length scales, the interactions between the solid container and the liquid-liquid interface become important. This means that unlike in classic rayleigh-taylor instablilities, we are not dealing with a flat interface, instead we will have a curved interface. This interface is governed by minimization of surface area and the condtition that contact angle must be in agreement with the physics governing solid and liquid-liquid interface interactions. This is only at equillibrium. When the contact line i.e. the line common to the solid and the liquid-liquid interface is moving, the contact angle also varies. There has been litraature on how the contact angle varies with contact line velocity. The basic schematic of the problem statement is: