How can a Gecko climb a wall?

A rough estimation of the van-der-Waals interactions between the palm of our hands and any kind of wall results in forces that are more than sufficient to overcome gravity. Thus we should be able to climb walls just like geckos do. Obviously this is not consistent with our every-day-life experience. So, where is the problem?

Van-der-Waals interactions decrease exponentially with the distance of the interaction partners. Single molecules, which are the focus of environmental chemistry, can approach interactions partners until their electron clouds start to overlap, i.e. they can make the maximal use of the van-der-Waals interaction energy. The same is true for liquids on (molecularly) smooth surfaces. But if one brings together two rough surfaces, then there will be only a few contact points per unit surface area where the two surfaces directly touch each other. These few points of direct contact will make the surfaces stay apart from each other because the surfaces are too rigid to adjust to each other. The distance that will inevitably remain between two interacting rough solid surfaces does explain why there is not the expected attraction between our hands and a wall.

How does a gecko overcome this problem? The gecko's feet are covered with a very large number of fine flexible filaments. These filaments can bent independently and thus adjust even to rough surfaces. The endpoints of these filaments are enlarged (see photo in the link below) so that there is enough contact area for the van-der-Waals interactions to easily support the gecko against gravity.

The flexibility of the filaments and the whole foot has another important effect. Imagine how difficult it would be for a gecko to detach his foot from the wall if the van der Waals adhesion has to be overcome all at once. The trick is to detach the foot gradually such that the filaments detach bit by bit. This requires very little strength. One can compare this to the task of tearing apart a telephone book: this is easy if one does it page by page but it is impossible to tear apart all pages together.

See also link "Gecko's amazing sticky feet"

Recently Stanford University has presented a Gecko robot whose feet mimic the real gecko feet:
http://www.youtube.com/watch?v=odAifbpDbhs