The presentation will touch on two subjects. The first will be author's own results on the transport properties of rippled graphene. While it is often depicted as ideally flat plane, in reality both graphene on substrate and in suspended samples typically exhibit ripples. These are caused either by direct interaction with the substrate, thermodynamical instability inherent to 2D systems or functionalization (e.g. by OH groups). The out-of-plane deviation is usually in the range of few Angstroms and lateral wavelengths range between tens and few hundreds nanometers. The transport properties, including magnetoconductance, were studied using using single-band tight-binding model. Both the bond-length variation, and fluctuating scalar potential were included in the formalism. The samples were modeled as self-similar surfaces characterized by the roughness exponent with values ranging from typical for graphene on SiO₂ to those seen in suspended samples. The range of calculated resistivities and mobilities overlaps with experiment. This indicates that scattering on ripples might be one of the important factors ultimately limiting the mobility of carriers in graphene.

The second part of the presentation will be devoted to the discussion of the state of the research on graphene nanomeshes. These are manufactured by litographically patterning a graphene flake with an array of antidots (holes). The resulting structure can be seen as equivalent to the connected network of nanoribbons, with the band gap opening in electronic structure for suitably chosen geometries (the neck widths is the main parameter). The result is vastly improved on/off ratio for nanomesh-based field effect devices, which addresses one of the main problems hindering the practical applications of graphene transistors. At the same time the currents supported by the nanomesh devices can be up to 100 time greater than a single nanoribbon would permit. A robust spin-polarization, possibly originating at internal zig-zag edges of antidots, has been reported experimentally which makes nanomesh systems interesting candidates for spintronic applications. However, relatively little attention has been devoted so far to studying magnetotransport in these structures. The same is true about the heat transport, the latter case being especially interesting in view of the fact that patterning tend to quench the phonon degrees of freedom an increase the figure of merit.