In this article, techniques related to the unitary cut methods for loop calculations of four-dimensional super Yang-Mills theory are developed. These are inspired by recent progress in a generating-functional expression for gluon amplitudes based on the maximally helicity violating (MHV) expansion of the amplitudes. There are two types of techniques that are presented in this article. One is an algebraic one and the other is a diagrammatic one. The former automatically incorporates Schouten's identity. The latter does not include it but has an advantage in giving straightforward graphical rules. The authors provide many examples of the use of these techniques. Some of these are of direct relevance to the calculation of four-loop amplitudes. In fact, very recently, a complete four-loop four-point amplitude in $\mathcal{N} = 4$ super Yang-Mills theory is obtained along these lines of developments [1]. The article also discusses applications of the results to theories with less-than-maximal supersymmetry and to $\mathcal{N} = 8$ supergravity.

References

[1] Z. Bern, J. J. M. Carrasco, L. J. Dixon, H. Johansson and R. Roiban, arXiv:1008.3327 [hep-th].