Variational formulas for the Selberg zeta function and applications to curvature asymptotics

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Résumé :In the first part of this talk, we will introduce the Selberg zeta function and its relatives. We will recall the celebrated Selberg trace formula, and the geometric setting of our work, the Teichmüller space of Riemann surfaces of genus, g. As shown by Zograf and Takhtajan, the Selberg trace formula connects the Ricci curvature of the Hodge bundle $H^0(K^m)$ over Teichmüller space together with the second variation of the Selberg zeta function at integer points. We will conclude the first part of this talk by explaining this connection and the role of the Selberg trace formula in its derivation.
In the second part of the talk, we will investigate the behavior of the Selberg zeta function, $Z(s)$, as a function on Teichmüller space. We will deduce an explicit formula for the second variation of $\log(Z(s))$ via a certain infinite sum involving lengths of closed geodesics of the underlying surface and their variations. We will then utilize this formula to study the asymptotics of the second variation of $\log(Z(s))$ as $s \to \infty$. We shall see that the most prominent role is played by the systole geodesics. Moreover, the dimension of the kernel of the first variation of the latter appears in the signature of the Hessian of $\log Z(s)$ for large s. In conclusion, we will show how our variational formula and its asymptotics have interesting implications for the curvature of the Hodge bundle and its relationship to the Quillen curvature.
The talk is aimed at a general audience with some familiarity in analysis, differential and complex geometry, and would be suitable for both doctoral students as well as more senior researchers.

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