Abstract

We consider the problem of maintaining an approximately maximum (fractional) matching and an approximately minimum vertex cover in a dynamic graph. Starting with the seminal paper by Onak and Rubinfeld [STOC 2010], this problem has received significant attention in recent years. There remains, however, a polynomial gap between the best known worst case update time and the best known amortised update time for this problem, even after allowing for randomisation. Specifically, Bernstein and Stein [ICALP 2015, SODA 2016] have the best known worst case update time. They present a deterministic data structure with approximation ratio $(3/2+\epsilon)$ and worst case update time $O(m^{1/4}/\epsilon^2)$, where m is the number of edges in the graph. In recent past, Gupta and Peng [FOCS 2013] gave a deterministic data structure with approximation ratio $(1+\epsilon)$ and worst case update time $O(\sqrt{m}/\epsilon^2)$. No known randomised data structure beats the worst case update times of these two results. In contrast, the paper by Onak and Rubinfeld [STOC 2010] gave a randomised data structure with approximation ratio $O(1)$ and amortised update time $O(\log^2 n)$, where n is the number of nodes in the graph. This was later improved by Baswana, Gupta and Sen [FOCS 2011] and Solomon [FOCS 2016], leading to a randomised date structure with approximation ratio 2 and amortised update time $O(1)$. We bridge the polynomial gap between the worst case and amortised update times for this problem, without using any randomisation. We present a deterministic data structure with approximation ratio $(2+\epsilon)$ and worst case update time $O(\log^3 n)$, for all sufficiently small constants ϵ.