

Surgical workflow mining and outlier detection using endoscopic video logs

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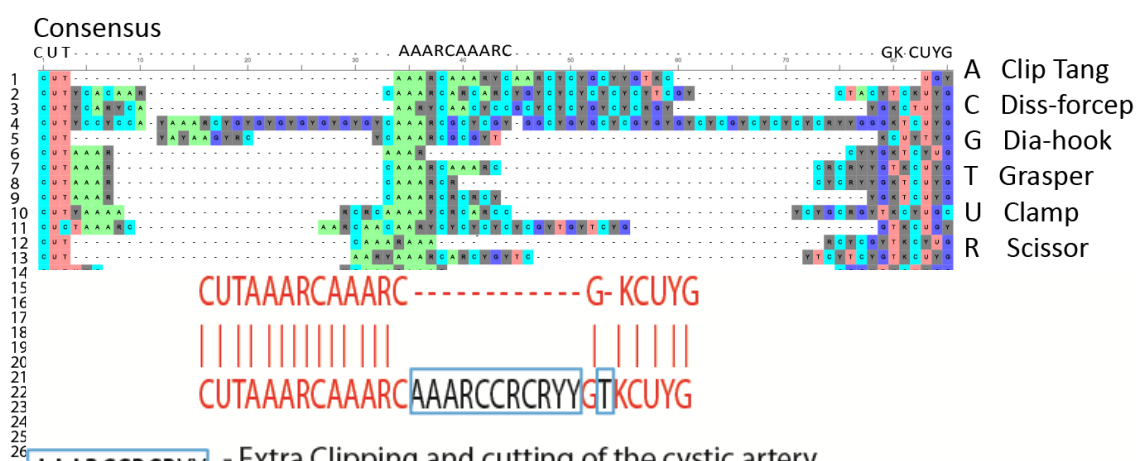
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Purpose: The purpose of this study is twofold: (1) to derive a workflow consensus from multiple surgical activity logs and (2) to detect workflow outliers automatically and without prior knowledge from surgeons.

Methods: A surgical activity log is directly derived for each surgery from laparoscopic video using an already developed instrument tracking tool. Workflow mining is used to derive consensus workflow from multiple surgical activity logs using tree-guided multiple sequence alignment. To detect outliers, a global pair-wise sequence alignment (Needleman-Wunsch) algorithm is used. The proposed method is validated using laparoscopic cholecystectomies (LAPCHOL).

Results: In total 26 surgery logs are used to derive the consensus for laparoscopic cholecystectomy with the multi-alignment method as illustrated in Figure 1. The derived consensus confirms to the main steps of laparoscopic cholecystectomy as described in best practices. Using global pair-wise alignment, we showed that outliers can be detected from surgeries using the consensus and the surgical activity log as illustrated in Figure 2.

Conclusion: Alignment techniques can be used to derive consensus and to detect outliers from clinical activity logs. Detecting outliers particularly in surgery is a main step to automatically mine and analyze the underlying cause of these outliers and improve surgical practices.



AAARCCRCRY - Extra Clipping and cutting of the cystic artery.

- Endobag inserted right after clipping, before removal totally finished.

T - Extra grasping required to pull the gallblader in the endobag.



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Figure 2: Using global alignment to detect outliers