DETECTION OF MILK EJECTION DURING THE HUMAN MILK EXPRESSION: CONTINUOUS ASSESSMENT OF MILK VOLUME

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Currently there is no simple method available for the assessment of milk removal and milk flow profiles in women who use an electric breast pump. Milk expression may be described as a series of milk ducts dilatations (milk ejections) that lead to a rapid increase in milk flow rate during an expression. When multiple milk ejections occur, the amount of milk expressed diminishes with successive milk ejections. Mothers (n=23) expressed for 15 minutes and milk flow rates were recorded every 5 seconds (≤5 grams per interval). Up to 7 milk ejections were observed per expression and duration of a single milk ejection ranged from 30 seconds to 12 minutes. We developed an algorithm that identifies milk ejections in real time. This method relies on a time series interpretation of the milk volumes expressed and it incorporates constraints dictated by the milk flow properties. Time index of the initial milk ejection is detected as the first non-zero run of smoothed monotonic milk volumes while time indices of subsequent milk ejections are identified using moving average with data driven bandwidth window designed to detect monotonic runs of locally smoothed milk volumes. These bandwidths depend on the number of prior milk ejections, maximal flows and total duration of the already observed milk flow. This algorithm performs well in detecting milk ejections. It may allow optimization of expression duration, since it can be used to predict a likelihood of another milk ejection.