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Probabilistic methods for tracking people and understanding motion.

Increasingly we want computers to observe us and know who we are and what we are doing. We want to direct our computers and robots by gestures. We want our robots to understand the actions of nearby people. We are building a system that tracks players in video broadcasts of the game of ice hockey so that we can understand their position and movements at critical moments in the game. Our system inputs videos of hockey (or other sport) games and builds a database of the paths of individual players during the game. Our idea is to produce a coaching assistant's database that can answer queries about the game or practice such as: Where were the defencemen during the play leading up to the goal at 10:52 in the first period? How did the opposing team break out of their zone in the rushes that lead to shots on goal? We track the players' positions in video sequences, and then correct them so that they appear as if taken by an overhead camera. The project opens up opportunities to study tracking, motion recognition, spatiotemporal structure identification, video databases and motion perception. Recently we have made significant progress in rectifying long sequences and in tracking players in these long sequences, despite fast movement and numerous occlusions. From these sequences we can now study how players move during the game, as they skate, turn, handle the puck, receive passes and shoot the puck. For several years we have been studying how to construct systems can collaborate with people. Robot partners must be aware of people's locations and movements as well as their actions. In particular, facial expressions and movements communicate to a listener useful information about the speaker during a conversation. We have developed powerful tools to learn facial movements and adapt to them in interaction. These same tools should now permit us to learn how players move in hockey plays. Of course we can't find the puck yet - it is too small and moves too fast! But given the positions of the players and their movements we should soon be able to identify where the puck is by how people move during the game of hockey.

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