

# Team Canuck 2003

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**Abstract.** This paper contains an overview of Team Canuck. We will describe mechanical and electrical designs of the robots, and vision and control software that compute the state of the game and commands for the robots. Past experience and future plans for Team Canuck will be described as well.

## 1 Introduction

Team Canuck is the F-180 RoboCup team hailing from the University of Alberta located in Edmonton, Alberta, Canada. It is the first Canadian entry in RoboCup F-180 and is composed mostly of Computing Science and Electrical Engineering graduate students.

### 1.1 Team History

Team Canuck was formed in September 2000. We successfully qualified for our first RoboCup in 2001 and we have competed in Seattle (2001) and in Fukuoka (2002). RoboCup 2002 was a very successful year for Team Canuck compared to 2001. 2001 proved to be an interesting and rewarding learning experience for our team because of several technical difficulties we experienced as a rookie team. These difficulties were related to both system hardware and the vision software. However, in 2002, we overcame all of the previous technical difficulties and managed to finish in 3<sup>rd</sup> place in our pool.

Presently Team Canuck 2003 plans to qualify easily for RoboCup 2003 and, assuming we receive the necessary funding, to be a competitive entry in Padua, Italy at RoboCup 2003.

## **1.2 Team Members**

Team Canuck consists of five team members, six robots, and an array of computers, cameras and other associated hardware. The five team members are all currently associates of the University of Alberta. Dr. Hong Zhang is Team Leader and faculty advisor of Team Canuck from the Department of Computing Science. Jonathan Kelly, Matthew McNaughton, and Andrzej Zadorozny are all M.Sc. students in Computing Science. Sean Verret is an M.Sc. student in Electrical Engineering.

## **1.3 Collective Robotics at the University of Alberta**

Team Canuck provides a platform for several students and team members to conduct research in several areas of multi-agent systems and collective robotics. Although, the actual robots of Team Canuck do not yet fully exploit the potential of collective intelligence research, it is our goal to eventually have a fully collective robotic soccer team in the F-180 league of RoboCup. Some of the collective research currently ongoing at the U of A includes collective building, collective sorting and evolutionary computation applied to collective robotics.

# **2 Robot Hardware Description**

Below is a very brief description of the micro-controller, motor control circuitry, chassis, motors, wheels, and radios used by Team Canuck.

## **2.1 Micro-controller (MCU) and Motor Controller Circuitry**

Team Canuck uses the mini-robomind (MRM) as the control computer on board of each robot. The MRM contains a MC68HC332 at 25MHz as well as 512k flash EPROM. This board provides us with more than enough computing power for the time being and will be a staple to our team in the future.

Team Canuck uses a standard L293 h-bridge interface to drive its two motors. The signals used to control the motors come from the TPU of the MCU of the MC68HC332.

## **2.2 Chassis**

The machine shop in Department of Mechanical Engineering at the University of Alberta fabricated the chassis of our robots. The chassis is constructed out of  $\frac{1}{8}$ <sup>th</sup> inch aluminum. There are two main plates or tiers. The bottom plate holds the motors, kicker parts and batteries; the top plate holds all the control circuitry, and the

radio. For 2003, we are not looking to make any major hardware changes to our robots.

### **2.3 Motors and Wheels**

Team Canuck uses Faulhaber motors purchased from MicroMo. These motors are the DC coreless motors 2224 series. In 2001 and 2002 we used these motors with a 23:1 gear ratio, but for 2003 we will experiment with a 14:1 gear ratio in hope of speeding up our robots. These motors also provide 16-bit quadrature encoder feedback to our MCU to allow closed-loop velocity and position control of the wheels.

Team Canuck uses 2" airplane wheels from Robart and we use an aluminum hub created by the Mechanical Engineering department at the University of Alberta. Differential drive is used for steering.

### **2.4 Radio**

Team Canuck uses the RPC radiometrix product for its wireless communication. In 2001 our attempt at using another system (the Unilink) failed at competition and is not recommended.

## **3 Software Description**

Team Canuck uses several different software and firmware packages/languages when programming its agents, MCUs, and vision software.

### **3.1 Agent Programming**

Team Canuck has created several different agents for each of the different types of soccer players that exist. Specifically, we have a goalie agent, defense agent, and a forward agent. All of these agents are written in C++ and interact with the vision system and the radio system. These agents currently do not interact with each other, but hopefully for RoboCup 2003 cooperation among the various agents will be introduced to improve the quality of play.

### **3.2 Programming the 332**

Team Canuck uses a GNU C cross-compiler to program its MCUs from a Linux host. We are also currently looking into a method of using the Linux tool "gdb" to reduce the code downloading time.

### **3.3 Network Communication**

Currently Team Canuck has several programs running at once on a local area network. In order for this to operate successfully, communication must occur between the different levels of programs. We have created a UDP protocol so that the vision system can communicate to each of the individual agents the current state of the field (robot and ball positions). UDP protocol is also used so that the software agents can transmit commands to the robots using a single common radio channel.

## **4 Vision System**

Team Canuck uses a Point Grey Research Firefly Firewire camera to capture images of 640x480 pixels into a computer running Linux 2.4.

The colors of the ball and the identifying swatches on the robots are classified using a simple manually-tuned mapping from the RGB space to color categories. Color categories are specified by projections onto the RG, RB, and GB color planes.

The color mapping is further tuned by dividing the field into 16 equal portions with independently-variable brightness factors. Restricting the brightness adjustment to a small number of distinct areas results in a noticeable speed increase over per-pixel brightness lookup tables, without unduly sacrificing expressiveness.

Robot identity and orientation are determined using a simple 3-dot/2-color pattern.

Finally, the vision system uses all of this information to pass on a UDP packet to our agents that contains the current state of the field. This UDP packet contains information about the position of the ball, the position of our opponents' robots, and finally the position and orientation of our robots.

## **5 Conclusion**

Team Canuck is a team with a relatively short history. Many lessons were learned in Seattle and Fukuoka, and we are taking these experiences to improve our robots. We plan to use a 3-CCD camera (hardware) and tracking (software) to improve our vision performance. We also are updating the GUI for our robots and hope to add even more functionality. Plans are also currently in the works to reduce the individual weight of each of our robots as well as refining the solenoid-powered kicker. Finally, we hope to add the ability of holonomic motion to our robots but will unlikely be able to feature this at RoboCup 2003.