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ROBOTS

University of Plymouth professor hopes to teach musical robots to interact with humans

Robots learn through music

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A UK scientist has persuaded robots to sing to one another in research that has implications for co-operating autonomous machines.

"This is not only about music. Robots could agree collective strategies to perform a task together and develop learning strategies," Eduardo Miranda, professor of computer music at the University of Plymouth, told *EW*.

According to Miranda, the human brain processes different aspects of music in various places, some of which are specific to music and others that are not so specific. The brain uses these different functions to relate sequences it has heard to previously remembered sequences.

Miranda's robots mimic human vocal tract and hearing, and are programmed to behave like certain brain functions thought to exist in humans which recognise when a sound they hear is similar to a sound their host has produced.

Initially, the Plymouth robots babble melodies randomly. When incoming sounds are judged similar to remembered sounds, the robot can respond with an imitation of the incoming sound.

"The task is to produce two sounds alike. The robots have a set of criteria to select sounds. Certain sounds are discarded and certain sounds are kept," says Miranda.

Up to 20 virtual robots were run in an experiment, picked randomly in pairs, to spend some time interacting with actual robots – DRK8000s from Dr Robot.

Miranda moved from a computer model to physical robots because he eventually wants to develop robots that interact with humans. "They will learn from me and I will learn from them."

According to Miranda, attempts so far to persuade machines to make music together have used abstract algorithms embodying pattern genera-



Robots at the University of Plymouth are learning to make music together – Eduardo Miranda, professor of computer music, is their teacher

tion features suitable for making music, such as cellular automata and particle swarms, or music knowledge-based techniques such as symbolic machine learning or neural networks, armed with music theory and learning from existing music. The former tend to produce complex material few people recognise as music, while the latter generally produce music similar to the training pieces.

Miranda's approach differs in avoiding manually programming prescribed rules for generating music, but attempts to program the robots with the ability to develop suitable musical rules themselves.

To keep things simple, only short tone sequences have been allowed in Miranda's experiments, stored as parameters that describe lung pressure, throat position and vocal chord tension for each tone.

In a typical interaction giving pairs 20 tunes to communicate, a group of five robots developed on average 19 tunes each after around 2,000 interactions. ●

University of Plymouth
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KEY POINTS

- Scientist develops robots that can recognise and imitate sounds
- Different approach means robots are able to develop musical rules themselves
- Robots could agree collective strategies to perform a task together

Giving pairs 20 tunes to communicate, a group of five robots developed on average 19 tunes each

SEMICONDUCTORS

Future Horizons positively cautious

DAVID MANNERS
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Future Horizons has revised its semiconductor forecast for the year to 4-5% growth, with 4-6% growth predicted for 2009.

"On the one hand, at a stroke the world's financial ecosystem became dysfunctional; on the other hand, the chip industry continues to march on," says Malcolm Penn, CEO of Future Horizons, in the company's October semiconductor industry report.

However, the effect of an IMF forecast, which is looking at 2009 world gross domestic product (GDP) growth of 3%, with 6.1% coming from emerging economies and 0.5% coming from the advanced economies, makes the company cautious.

The IMF forecast of 3.9% world GDP growth for this year, up on its 3.7% forecast in March, suggests the chip market is still growing.

The Future Horizons report points out that the chip market is not indissolubly wedded to the economy. "There have been seven instances in the past 22 years where the chip market has grown in value during a period of slowing economic growth, and two occasions when it has declined in a period of GDP growth," the report says.

"IC units have exhibited three periods when they grew in the face of a GDP decline and five occasions when the units declined despite growth in world GDP. The economy is thus not quite king; inventory, excess capacity and average selling prices (ASPs) also play a role."

Fundamentally, Future Horizons believes the semiconductor industry stays strong. "Inventories do not seem to be seriously bloated, wafer fab capacity utilisation levels are high, capital expenditure is low and has been now for several quarters, and ASPs are in the midst of a long-term structural recovery phase," says the company's report. ●

Future Horizons
www.futurehorizons.com