On the Informational Requirements of Indian Cooking

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Abstract

This short note is inspired by Prof. S. K. Mitter's comments on the informational requirements of Indian cooking, made in response to Prof. D. Shah's "Salt Lemma" on September 20. It casts cooking as a problem of controlling a dynamical system; the system may be stable or unstable (depending on the cook and the food being cooked). It discusses a scenario where there is a local actuator/observer and a distant controller, connected through a communication link. The communication link is modeled after a parallel channel that has recently been deployed in India, connecting Lucknow to rural villages. Comments on the Indian notion of jūṭhāpana and its inducement of noisy observations are also made.

The Problem of Cooking

Cooking typically involves a cook following a recipe to transform ingredients into food. Following a systems theoretic approach, the ingredients are the system inputs, the cooked food is the system output, the recipe is the system input-output map (often specified in an inexact way), and the cook is an actuator/observer/controller. Often when cooking, the recipe is not implemented exactly, and the system is perturbed. When such a perturbation occurs, the cook must use some control strategy to return the system to its intended trajectory. The perturbation usually does not cause the system to become unstable, however it is definitely possible. The ability to deal with perturbations is the sign of an expert cook. Some recipes are more prone to instability than others. As an example from Indian cooking, systems that involve turmeric as an input are quite prone to instability. Too little turmeric results in food that is insipid, whereas too much turmeric results in food that is overly bitter.

Cooking at a Distance

Consider a situation where one wants to recreate food from a proximate point at a distant point, assuming that there is no knowledge of cooking at this distant point. We will denote the proximate point as *mother*, and the distant point as *son*. Clearly, one must transmit the system input-output map, as specified by the recipe, from the mother to the son. Furthermore, the son must be able to implement the mother's control strategy. Often, however, this control strategy is not specifiable in a form that allows it to be communicated from the mother to the son. If however, there is a communication link with sufficient reliability and low latency, the mother's controller can directly control the system through the son's actuator. There is an interesting question regarding the channel requirements for such a cooking at a distance problem. Communication of the recipe apparently does not have particular latency requirements but may have large capacity requirements, whereas communication of the observations from the son to the mother and the control signals from the mother to the son apparently have small capacity requirements but significant latency requirements. Thus it appears that there are two qualitatively different information streams that are involved in the mother–son communication procedure, in a fashion similar to the anytime information theory results on exponentially unstable stochastic processes shown by Sahai and Mitter [1].

An Information Theoretic Model of Postmanet

A communication system has recently been deployed to link Lucknow, the capital of Uttar Pradesh, India, to surrounding rural villages such as Madantoosi. It is based on using the postal system to transport rewritable storage devices, such as DVDs, as a mechanism for communication. This channel has large capacity but also large latency, and is termed a high-latency high-bandwidth (HLHB) channel[1]. There also exists an independent channel that is based on a traditional radio connection, which is termed a low-latency low-bandwidth (LLLB) channel [2]. Collectively, we will refer to these two parallel channels as the postmanet channel. It seems quite reasonable to model the postal portion of the postmanet channel as an L-ary erasure channel with large but finite L and large inter-use time. (As noted by A. Sahai in personal communication, there is a significant difference between latency and blocklength.) Further, it is reasonable to model the radio portion of the postmanet channel as an AWGN channel with small signal to noise ratio and small inter-use time. It is known that the L-ary erasure channel may have zero anytime capacity but large Shannon capacity. The AWGN channel, on the other hand has approximately the same Shannon and anytime capacities. Thus it seems quite reasonable to use the postal portion of the postmanet channel to transmit the recipe, and the radio portion of the postmanet channel to transmit the observations and control to achieve good performance.

The Concept of Jūṭhāpana and Noisy Measurements

One interesting problem that arises in Indian cooking, as opposed to other types of cooking is that the observer is not allowed to taste the food while it is being made. This restriction against "tasting the sauce with the wooden spoon" is due to the cultural prohibition against making the food jūṭhā.[2] Consequently, the observer is severely limited in the observations that he can make. The visual appearance and the sound (which may be observed) are jointly distributed with the taste. Thus the coding of the observations turns into an anytime version of the noisy source problem [4].

Conclusion

This note looks at the problem of cooking over a communication link, specifically focusing on Indian cooking over the postmanet channel, which has been deployed in India. Applications may include home economics extension courses for people in rural areas, as pioneered by Martha Van Rensselaer of Cornell University in the early 20th century. Furthermore, it suggests new problems in systems and information theory, related to anytime information theory.

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Addendum (October 3, 2005)

Although the original intent of this parody was to poke fun at information theorists for looking at life through the lens of information theory too often, upon further contemplation of what I have written, it seems that the type of system that I outlined, a "cooking system," is in fact a particular type of personal fabrication system, as envisioned by Prof. Neil Gershenfeld [5]. Thus my notion of channel requirements for cooking may be generalizable to channel requirements for streaming information to do fabrication, a theory of *fabrication in the presence of noise* as it were, to follow the naming convention of Shannon [6] and Elias [7]. Thus, the overall conclusion is that perhaps looking at life through information theory isn't such a bad thing after all.

[1] *Bandwidth* is used in the computer science sense.

[2] The concept does not seem to be easily translatable into English. In [3], the adjective *jūṭhā* is translated variously as "touched," "tasted," or "unfit for another's use." The verb *jūṭhārnā* is translated as "to taste food (and so make it impure for others)." As a cultural reference, this concept plays a role in the Śabarī episode of the Rāmāyaṇa.

References

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